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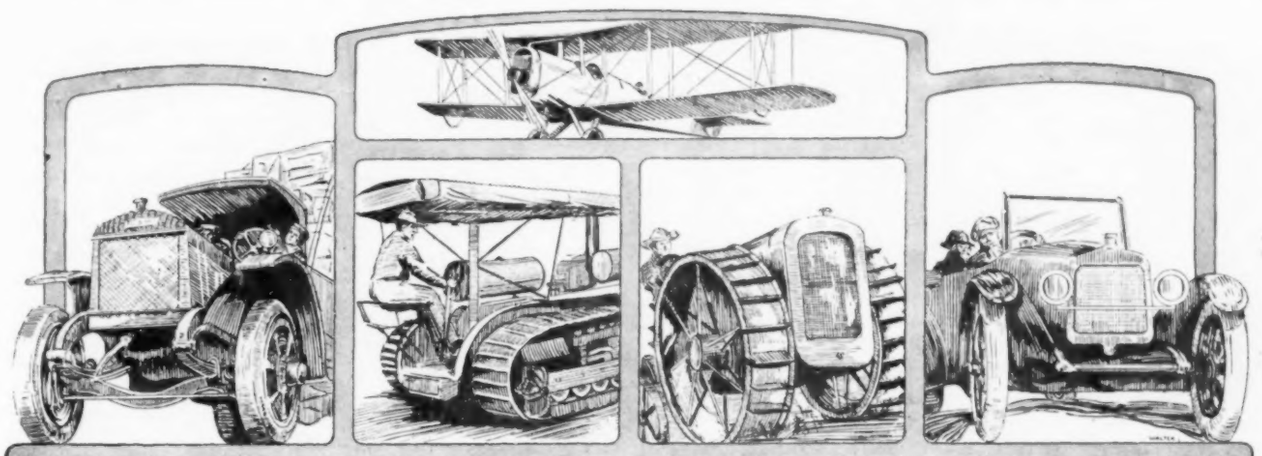

AUTOMOTIVE CONSTRUCTION

The Hispano-Suiza Airplane Engine—I

By H. O. C. ISENBERG
Works manager Wright-Martin Aircraft Corporation, New Brunswick (N. J.) plant.

One often hears the expressions "Built like a watch," "As accurate as a watch," implying that the article referred to is extremely accurate. As a matter of fact, if a watch were built to a degree of accuracy proportionate to the accuracy of the Hispano-Suiza airplane motor, it would be so very accurate that it would not function at all.

TO COVER the entire manufacture of the Hispano-Suiza motor would be a gigantic task and would probably not be worth publishing in the columns of the *American Machinist*. However, many puzzling problems have been solved at the Wright-Martin plant and as a large percentage of these are applicable to other lines of manufacture a description of them should be of value. It is therefore the intention in this series of articles to select for special mention only those high spots in manufacture which are considered of specific interest to the readers of this paper. However, before going into the manufacturing methods, a brief description of the plant and its facilities may be in order. The Wright-Martin Aircraft Corporation, New Brunswick plant, is located at the west end of the town on Jersey Avenue. It is divided into two sections, the northerly and southerly, and has a total area of approximately 18 acres. The number of employees is about 8123.

There are two railroad sidings on the property. The plant is easily accessible by motor vehicles and trucks in all seasons of the year, and two electric-railroad lines have terminals nearby. There are in all 37 buildings on the property, as shown in Fig. 1.

Weight is of prime importance in an airplane motor; further, within a very slight tolerance one motor must weigh the same as another motor of the same make and size. To attain this object all the components that go to the making of the motor must be incessantly watched during the process of manufacture.

With parts made from bar stock a slight variation in the density of the material or a slight variation in dimensions will cause wide variation in the weights of finished parts. The latter is of course eliminated by the inspection system while the former is not so easily detected. In castings uniform weight of the work requires careful watching; but perhaps, instead of indulging in platitudes, it will be better to give an outline of how work on a new airplane engine is started. After the tentative design is passed by the engineers in charge of the design, tracings and blueprints are made and copies of these are sent to the wood-pattern shop. In work such as this, the writer finds it obligatory to make a very accurate layout. Usually, in the pattern shop the layout is made on a board; in this shop sheet aluminum is used. This is coated with patternmakers' ordinary black shellac. After it is dry the layout is made full size with *single* shrinkage allowance, for it must be remembered that this first set of patterns is an experimental set to provide the castings for the experimental motor which will determine the wisdom of the engineer who designed the engine.

In the Wright-Martin plant layouts are made by men who are not only first-class draftsmen but efficient patternmakers as well. With the necessary tools and a sharp scriber the lines are scratched through the black-shellac surface so that they stand out clear white on the black background. When the layouts for the various parts are finished they are carefully inspected and checked to see that no errors have been made. The layouts then go to the patternmakers assigned to do the work. In this plant the wood patternmakers are obliged to work to a tolerance of 0.015 in. Usually for all wooden patterns and coreboxes high-grade mahogany is used.

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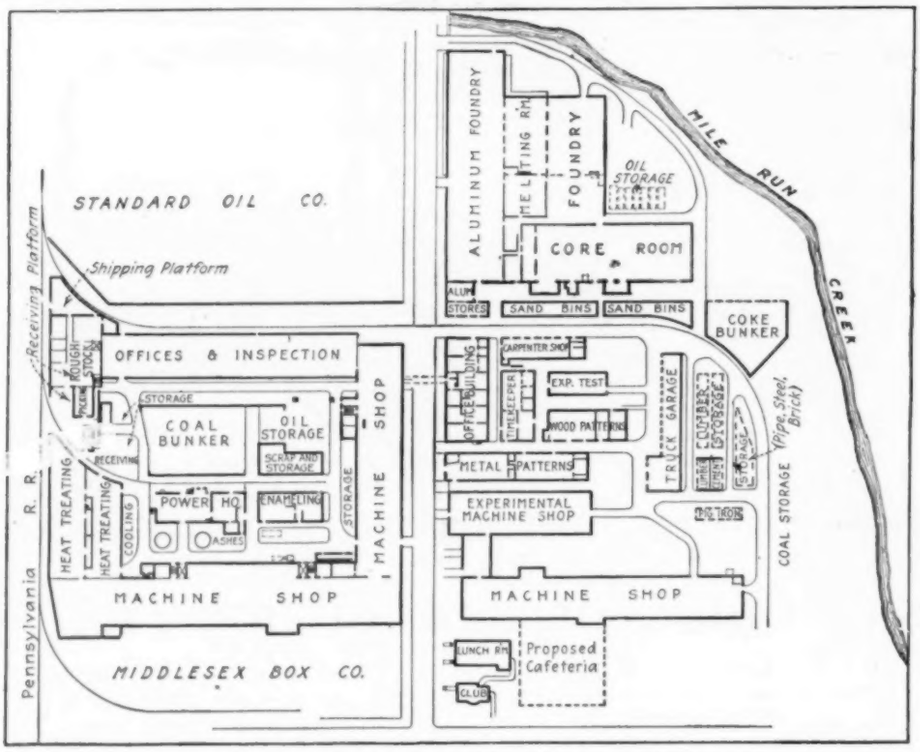


FIG. 1. MAP OF NEW BRUNSWICK PLANT

Mention may be made here that Detroit and Cleveland seem to have a mortgage on a large proportion of the men who are capable of turning out the grade of pattern work demanded in the production of airplane-motor castings. The reason for this is obvious, except for the refinements necessary in airplane work, as the cylinders, crank case and other castings used in high-grade automobiles are very similar. Therefore, many pattern-makers were imported from these cities.

The Hispano-Suiza engine passed through the experimental stage a good many months ago. However, an experimental set of patterns is, at this writing, going through the pattern shop, and while it is not for an airplane engine it will serve to illustrate, as it is just as accurately and nicely made as it would have been had it been for that purpose.

In Fig. 2 is shown the cylinder-block pattern made of high-grade mahogany. To the right the outside of the pattern is shown, while to the left is the parting face of the pattern. Four dowel pins are used with a single rapping and drawing plate in the center. In Fig. 3 the corebox for the barrel cores is shown. This also is made of mahogany and, except for its accuracy, is about the same as any other corebox for a barrel core.

In Fig. 4 is shown the corebox for the water-jacket core. This is somewhat more complicated. The core is supported in the mold by the print projections *A*, Fig. 4, resting in the depressions in the mold left by the prints *A*, Fig. 2. The projections *B* also enter the depressions left by the prints *B*, Fig. 4. There are six loose pieces in this corebox; two of them are shown at *C* and *D*. They fit at *E* when the coremaker is ready to make up a core. Similar pieces for the other side of the corebox are shown in place at *F* and *G*. The part *H* fits in the dovetails *I* and the part *J* forms the walls of the cylinders. The work on the patterns and coreboxes referred to amounts to about 200 hours.

In Figs. 5 and 6 are shown some smaller and simpler patterns and coreboxes. There is nothing remarkable about these except the extreme accuracy previously referred to. The machines and tools in this pattern shop are similar to those of any other well-equipped shop for work of a like nature.

In Fig. 7 are shown three wood-turning tools used in the shop. At *A* is the ordinary rough-turning tool, at *B* a finish-turning tool that is not so well known, and at *C* a parting tool that is still less well known. The two projecting points at each side shave the sides of the parting cut and leave a nice smooth surface.

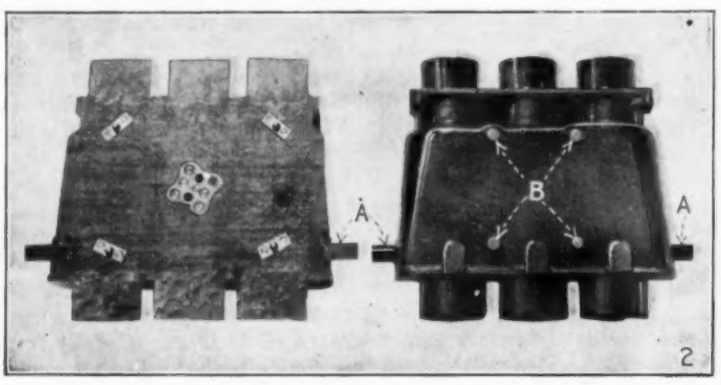


FIG. 2. EXPERIMENTAL CYLINDER-BLOCK PATTERN

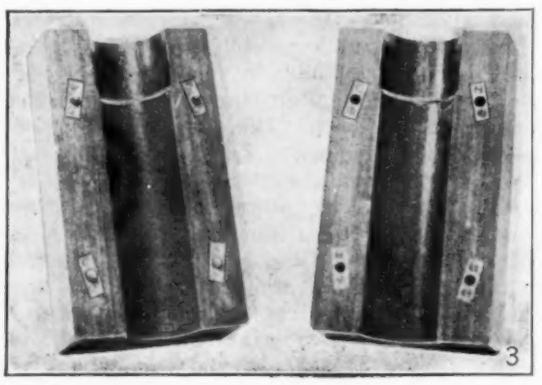
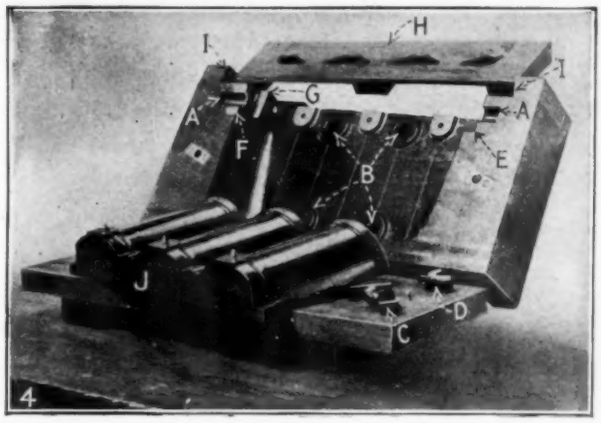
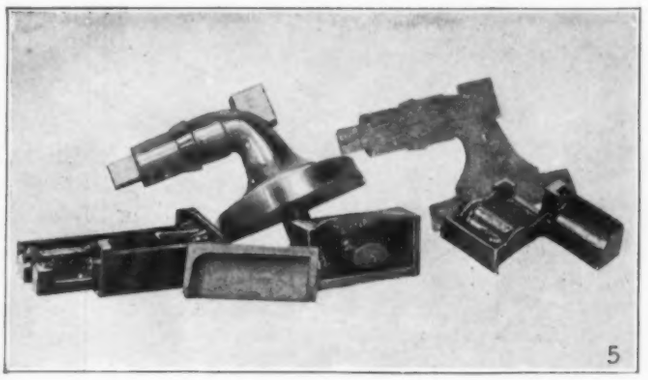
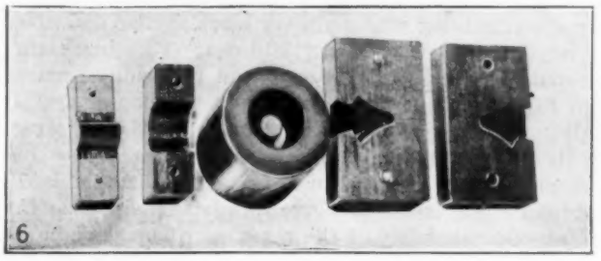


FIG. 3. COREBOX FOR BARREL CORES

AUTOMOTIVE CONSTRUCTION







FIGS. 4 TO 7. COREBOXES, PATTERN AND WOOD-TURNING TOOLS
Fig. 4—Water-jacket corebox. Fig. 5—Pattern for centrifugal pump. Fig. 6—Small coreboxes. Fig. 7—Turning tools for wood

After the experimental patterns are finished they are first rigidly inspected in the pattern shop for size and finish after which they go to the general-works inspector and by him are thoroughly inspected before being passed. Having passed this inspection they go to the foundry where a trial set of castings are made. These are again sent to the shop inspector who so far as possible checks all the dimensions to see that they agree with the design. The castings are then sawed in sections to see that the desired metal thicknesses have been obtained.

The castings being satisfactory or the patterns having been altered to make them so, sets of castings are made and sent through the shop; the engine built and given

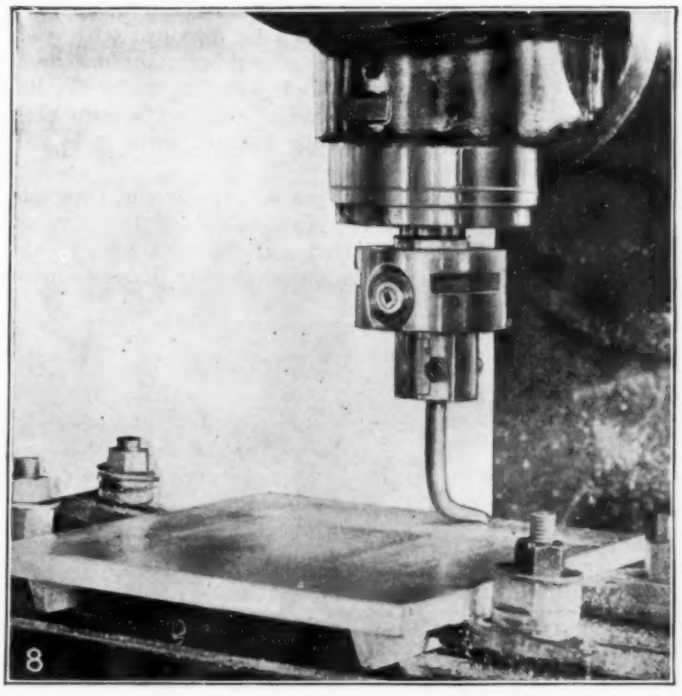


FIG. 8. ROUGH-SURFACING ALUMINUM PLATES

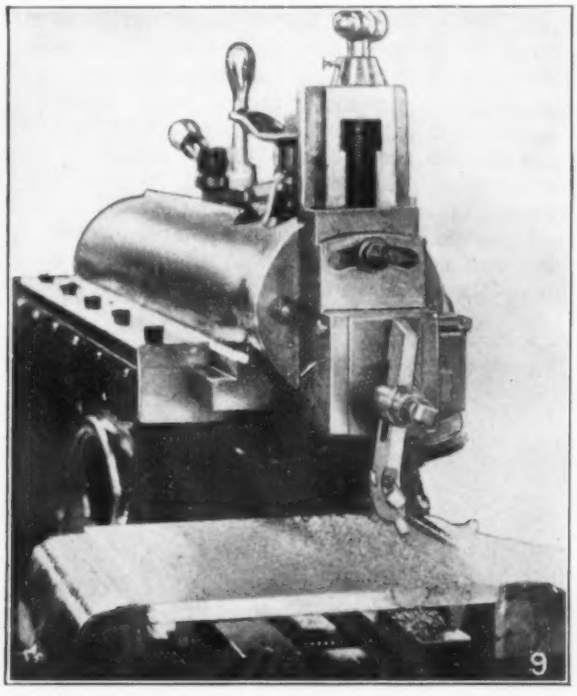


FIG. 9. FINISHING PLATES ON SHAPING MACHINE

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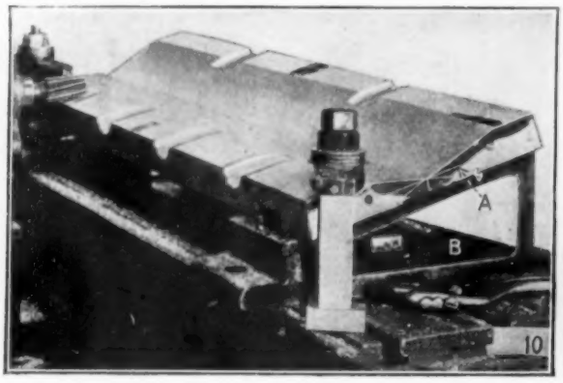

FIG. 10. DRIER FOR HEAD CORE

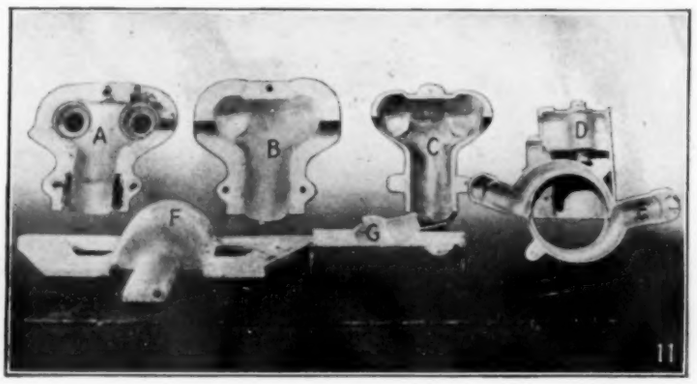

FIG. 11. SMALL METAL COREBOXES AND DRIERS

a thorough tryout. When the performance of the experimental engine has been pronounced satisfactory, work is begun on a set of master patterns. These also are made of wood, but with double shrinkage, as the working patterns are made from them.

The Metal Pattern Shop

The metal pattern-shop equipment for work of this character more nearly approximates the equipment for a toolroom than it does that of the ordinary metal pattern shop. We have all the toolroom equipment, lathes, planing machines, plain universal and vertical milling machines, with all the attachments which go with them, shaping machines, sensitive and radial drilling machines and a fairly large hardening furnace. The tolerance on the work from the metal pattern makers is 0.005 in. The bulk of the metal patterns are made from aluminum alloy as are also the plates to which plate patterns are attached.

In Fig. 8 is shown a roughing operation on aluminum plates, being done on a Cincinnati universal milling machine with the vertical attachment. The sweep tool is driven by a Marvin and Casler boring head. In Fig. 9 these same plates are shown being finished on a shaping machine. There is nothing out of the ordinary about the job except that it shows the metal shaping machine used in patternmaking. Fig. 10 shows the drier for a head core being machined on the milling machine. Each corebox is provided with a number of drier plates. They must be machined so as to retain the shape of the cores. When preparing metal patterns for machining they are varnished with ordinary black shellac and after drying the work is carefully laid out. This black surface with the scribed lines on it can be readily seen at *A* in Fig. 10. In the pattern shop a number of special angle plates are employed for producing the patterns. A pair of these special angles *B* are shown supporting each end of the drier. In this case the angle is 15 deg. and their use is of great assistance in assuring the interchangeability of the work, for it must be borne in mind that the drier plates may be used with any one of say half a dozen similar coreboxes in use at the same time in the coreroom.

The use of the driers will be shown later in connection with the description of the coreroom.

The Smaller Core Driers

In Fig. 11 are shown a number of smaller core driers. At *A* in this figure is one-half of a corebox for the intake port; at *B* is the other half of the corebox. At *C* is one of the driers for this core. As an operator can make a large number of these cores with one box a large number of driers must be provided with each corebox. *D*, *E*, *F* and *G* are also driers; the one at *E* is for a centrifugal pump for the cooling water for the engine. The reader can readily see that a core such as this must be very carefully handled while it is still moist and soft.

In Fig. 12 is shown a job set up on the faceplate of an engine lathe. The two halves of the corebox have been planed and fitted and the face next to the faceplate has also been surfaced so that it can be used

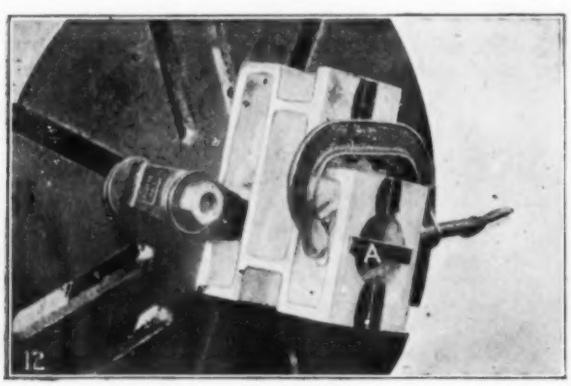

FIG. 12. COREBOX SET UP ON FACEPLATE

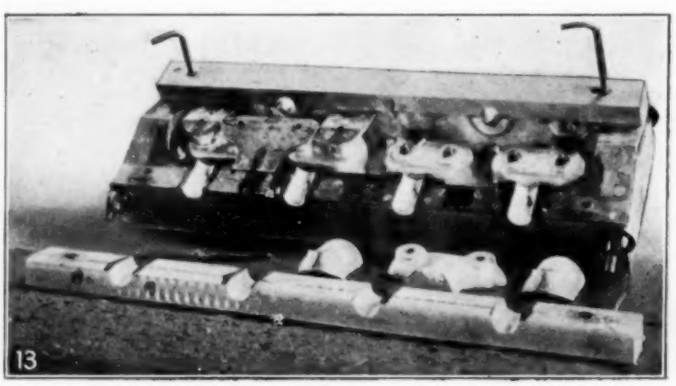

FIG. 13. BOX FOR HEAD CORE

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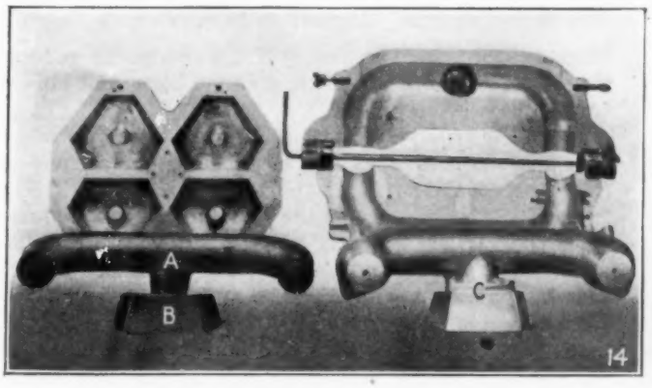


FIG. 14. PATTERN AND COREBOXES FOR INTAKE MANIFOLD

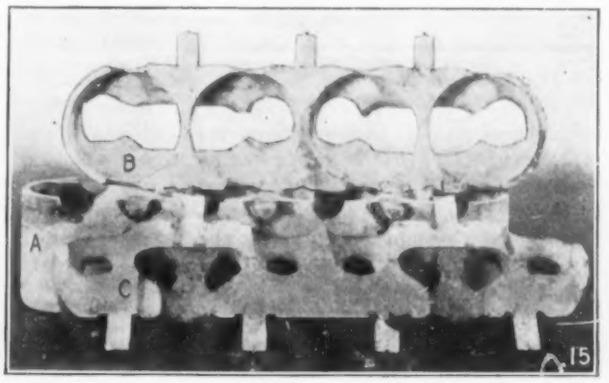


FIG. 15. PLASTER CASTS OF THE WATER-JACKET CORES

to locate for boring the hole at *A*. The job is clamped to the faceplate just as it might be clamped were it a toolmaker's job instead of one for the patternmaker.

In Fig. 13 is shown a box for a head core. One half of the box is shown with the loose pieces in place and the other half with them removed. As previously stated all the metal patterns and coreboxes are made of aluminum alloy. Aluminum is a very soft metal and core sand very abrasive in its action. For this reason all the faces of the patterns and coreboxes that are exposed to sand erosion are faced either with hard brass or as in this instance with steel. This is ordinary steel plate about $\frac{1}{8}$ in. thick. In the majority of cases it is attached to the face of the pattern with countersunk screws and when securely located in place, the surfaces and slots of the screwheads are made flush with the surrounding steel or brass plate by filling in with solder. But even with this protective sheet of steel the abrasive action of the sand soon shows itself, especially so in the case of coreboxes. This is due to the fact that a large percentage of sharp silica sand is used in the core mixture.

Description of the Pattern and Coreboxes For Intake Manifold

In Fig. 14 is shown the pattern and coreboxes for an intake manifold. Note how the corebox is hinged together and provided with swing bolts and thumb nuts to facilitate the work of the coremaker. On completion of a corebox the pattern-shop inspector takes a plaster cast of the core. This plaster cast is shown in Fig. 14 at *A*. In this case the core consists of two parts, the irregular hexagon *B* and the curved cylinder *A*, the hexagonal part fitting the print *C* at the center of the length of the manifold.

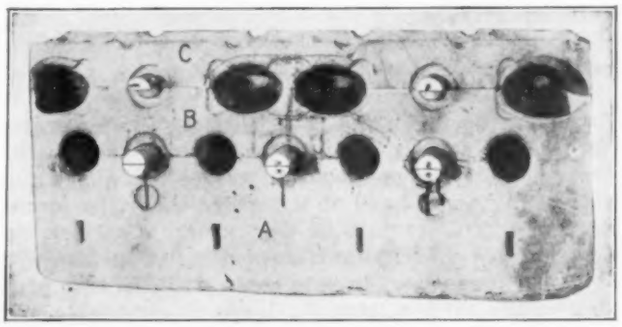


FIG. 16. PARTS OF FIG. 15 ASSEMBLED

In Figs. 15 and 16 are shown plaster casts of the water-jacket cores for the cylinder block. In Fig. 15 are shown the three parts *A*, *B*, *C*, that go to make up the complete water-jacket core shown in Fig. 16. In both these illustrations similar reference letters are used to indicate similar parts.

The Time-Study Man or Rate-Setter

By D. C. Cook

Gaylord G. Thompson, in his article on page 939 of the *American Machinist*, seems to be worrying over the correct designation for a time-study man or rate-setter.

But why worry over official designations when in the last analysis they are details of organization? Titles in modern business remind me of a certain kitchen utensil which is known as a frying pan, a skillet or a spider, according to the section of the country in which you live.

Payment of wages is based on certain time factors which are determined by making observations of various sorts with a view, primarily, toward obtaining maximum output in a minimum period of time. The success of this undertaking depends upon the personality of the individual making the observations and his method of using the stop watch. A stop watch is a dangerous tool and when conspicuously used, together with the impossible rates which are based on the reading of the split second hand rather than on sound judgment, will stir up more labor unrest than any other cause. The article also states that the time-study man has "thus far escaped the literary barrage laid down by the long- and short-range pens of various authorities." True, but has this individual escaped the scorn and hatred of shop men who have suffered through his inconsistencies?

Instead of endeavoring to determine their correct designation, I would suggest that more time-study men cultivate those personal characteristics that gain co-operation, rather than opposition, of shop men. The point of position, title and salary, as well as the adequacy of piece rates, will take care of themselves.

Flatness Tests at Bureau of Standards

By R. L. RANKIN

It is not so long ago that the scientist and his methods were looked upon with kindly condescension by the practical men of the shop. Fortunately, this attitude has been changed to a large extent by the valuable contributions of the laboratory to mechanical operations, among the best of them being those in the field of precise measurement. A quick and extremely accurate method of determining the degree of flatness of gage surfaces is here described.

SINCE the organization of the Gage Section of the Bureau of Standards in 1917 there have been frequent calls for tests of flatness of various steel surfaces, notably the contacts of measuring instruments. While the methods used by the Gage Section for such tests have long been known and utilized many manufacturers who have visited the bureau have expressed their surprise at the rapidity of this work which is accurate to one millionth of an inch.

The tests are made by means of the well-known principle of the interference of light. When light is reflected from two flat surfaces there is interference under certain conditions between the two sets of reflected light waves. The result is a series of light and dark bands known as interference fringes. Newton's rings formed by light reflected from the upper and lower surfaces of thin films of oil are interference fringes.

Another simple method of obtaining these fringes is by means of two glass true planes, or flats, as they are sometimes called. These true planes usually consist of a round piece of glass ground flat on one surface. When one of these true planes is placed on another the fringes referred to are seen by looking through the upper true plane. When monochromatic light—that is, light of one color—is used these fringes consist simply of light and dark bands. Thus with a sodium flame bright yellow and very dark bands are produced. The fringes may be seen clearly in ordinary daylight, however, in which case the various colors composing white light are separated into small rainbows in which the red and the green fringes are the most prominent. It is not necessary that both surfaces be of glass in order to obtain these results. While one glass flat is necessary the surface to be tested may be lapped steel. In any case there are two ways of using the true plane—it may be placed flat upon the surface to be tested or it may be placed in contact with this surface at one edge only, leaving a thin wedge of air between them. The latter method is preferable for testing flat surfaces or surfaces that are nearly flat.

If the surface being tested is really flat and the true plane is placed flat on this surface either all color is eliminated or else a uniform color spreads across the whole surface, depending on how close the two surfaces are pressed together. But if the true plane is held in such a way as to form a thin wedge of air between the two surfaces the interference fringes appear as straight lines. Fig. 1 shows such interference bands with flat surfaces. In one part of this figure the bands are widely separated because the taper of the wedge is reduced almost to the point at which a single color will appear across the whole surface.

When the true plane is placed flat on a surface which is not flat curved lines are seen instead of a sheet of color (unless the surface is perfectly cylindrical). Fig. 2 shows the appearance of the circular fringes produced when the surface tested is spherical. There are different methods of determining whether a surface of this kind is convex or concave. The simplest perhaps is to form a wedge of air between the two surfaces, as was done with the flat surfaces illustrated in Fig. 1. The fringes then become arcs of a circle the center of which moves farther and farther away as the taper of the wedge is increased. Fig. 3 shows such fringes. If the surface is convex the ends of these fringes curve toward the small part of the wedge; if the surface is concave the ends of the fringes bend away from the small part of the wedge. The small part of the wedge

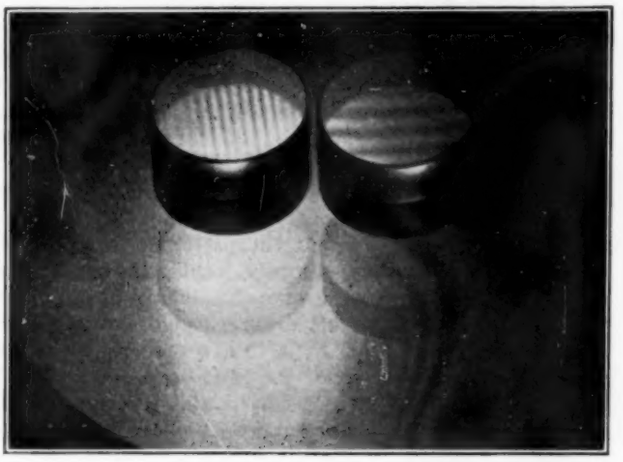


FIG. 1. INTERFERENCE FRINGES ON FLAT PLATE

in Fig. 3 is in the foreground and the ends of the lines turn in this direction. There the surface being tested is convex.

When a true plane is placed flat on a cylindrical surface, straight fringes appear that cannot be eliminated, as was done with the flat surfaces. When the wedge is formed the lines appear straight or curved, depending on the location of the closed part of the wedge. When the surface tested is the shape of a piece of egg shell, as is frequently the case with micrometer anvils, the fringes form ellipses when the plane is placed flat on the surface and are curved when the wedge is formed.

The convexity or concavity of any surface may be determined just as it was done with a spherical surface. In order to make sure of the shape of a surface this test with the wedge should always be made, and furthermore the small end of the wedge should be formed at two different points 90 deg. apart. Consider, for instance, a cylindrical surface and a flat surface with a burr on one edge. In both cases, with the true plane flat on the surface, straight lines appear that cannot be eliminated by pressing down on the true plane. Thus the wedge must be formed, and since a cylindrical sur-

face shows straight lines for one position of the wedge straight lines running perpendicular to each other must be formed in order to make sure that a surface is flat. This is shown in Fig. 1.

The shape of any kind of an irregular surface can be determined readily by means of the three settings already described; this is, with the true plane flat on the surface to be tested and in contact at each of two points that are 90 deg. apart. In every case, except when there is a burr on the surface tested, the true plane flat on this surface shows fringes that are contour lines of the surface, corresponding exactly to the contour lines that show the elevation of land on a map. The contour interval of the interference lines is 0.00001 inch.

After the determination of the general character of the surface being tested it is a simple matter to measure the exact amount that the surface is out of flat, no matter whether the true plane is placed flat on this

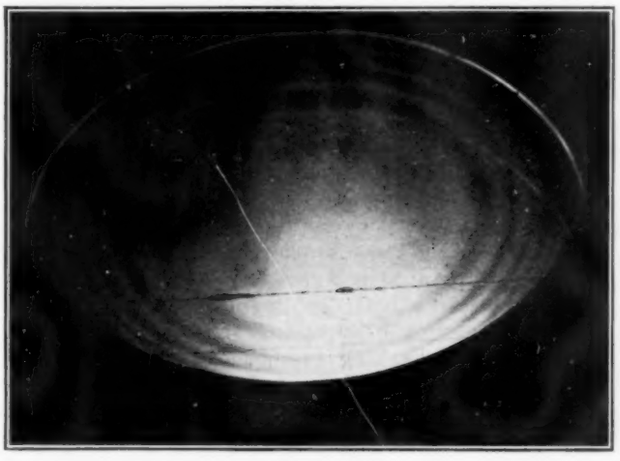


FIG. 2. INTERFERENCE FRINGES ON SPHERICAL SURFACE

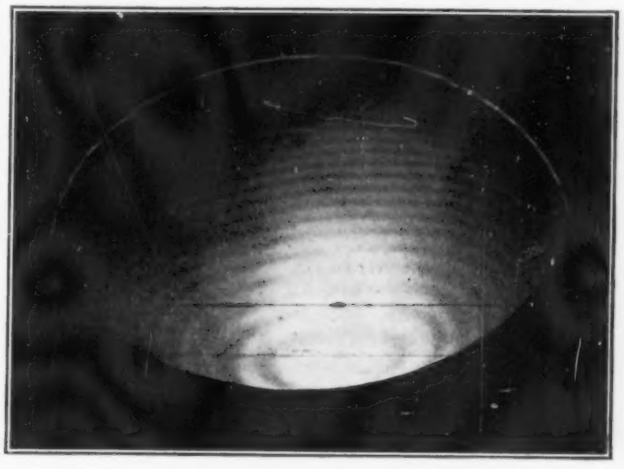


FIG. 3. SPHERICAL SURFACE WITH WEDGE OF AIR INCLUDED

surface or whether pressure is brought against one edge of the true plane in order to form a wedge of air between them. In the former case the number of circular fringes is counted from the center out to the edge. In the latter case a line is drawn tangent to one of the curved fringes and the number of other fringes which this tangent cuts will be the same as the number of circles counted before. Each of these circles or fringes cut by the tangent line represents an error of 0.00001 in. in the flatness of the surface. The exact value of a fringe depends upon the color, that is, the wave length, of the light used, but since these variations are of the order of only a few millionths of an inch, 0.00001 in. is an accurate enough figure to use for commercial work. For very precise work a good true plane is used, the color of the light is considered and readings accurate to 0.000001 in. are obtained by estimating to one-tenth of the distance between fringes.

In flatness tests made in the Gage Section the value reported gives the difference between the height of the surface in the middle and near the edge. If the surface is good and flat except around the very edge it is usually not necessary to consider the rounded edge when making a report. The surface shown in Figs. 2 and 3 is about 0.00006 in. out of flat. A tangent line is shown in Fig. 3, which may be used to determine the number of fringes cut, although this line should be across the center of the surface. It is not necessary to have the tangent line cut on the true plane at all; the edge of a piece of paper may be used. and with a little practice it is possible to count with the unaided eye the number of fringes cut.

A manufacturer who has any need for testing the flatness of surfaces should get a glass true plane for his own use. Tests may be made on any surface that is reasonably flat, such as the lapped surfaces of gages, straight-edges, the ends of flat-end standards, micrometer anvils and spindles and in fact practically any contact surface used in making measurements. Anyone can obtain very accurate results with a little practice. Care should be exercised not to scratch the true plane by rubbing it against surfaces that are not entirely free from grit, but the tests will be found very simple, even though the explanation of them may not appear so. Results are obtained with considerable rapidity. A micrometer manufacturer recently visited the Gage Section in order to have the results of his lapping inspected. The test took about as many minutes as the trip took days.

TABLE OF INTERFERENCE FRINGES

I. Surface	II. With True Plane Flat	III. With Wedge of Air	IV. Wedge Revolved 90°
Flat	No bands	Straight lines	Straight lines
Spherical	Circles	Arcs of circle	Arcs of circle
Cylindrical	Straight lines	Straight lines	Arcs of circle
Ellipsoidal	Ellipses	Curved lines	Sharply curved lines
Irregular	Figures formed by broken lines and curves	Broken lines and curves	Broken lines and curves
Flat with turned-up Edge	Straight lines	Straight lines	Straight lines

True planes flat within 0.00001 in. are sufficiently accurate for commercial work and should not be expensive. Manufacturers may make arrangements by writing to the director of the Bureau of Standards, for obtaining such true planes from the Bureau of Standards Optical Shop where those in use by the Gage Section were made. F. C. Weaver is in charge of this shop, which grinds the glass flat to 0.00001 in. or, when temperature conditions are good, to considerably better than that amount. For precise work Mr. Clacey, also of the Bureau of Standards, finishes the work by hand until it is flat to about one-tenth of that amount. Three true planes are tested one against the other, as is done with surface plates, to make sure that the surfaces are not spherical.

The table shows the kind of interference fringes given by different surfaces, as described above.

To obtain first the kind of lines shown in column III and then those shown in column IV (when these lines differ) there are of course certain positions at which the first wedge must be formed. Otherwise the order may be reversed or a combination of the two kinds of lines may be seen at the first trial, as described in the beginning of this article telling of a method for determining whether a surface is convex or concave.

The Detroit Institute of Technology

By A. R. Davis

Even before the entrance of the United States into the war the manufacturing industries of the country had begun to feel a scarcity of trained mechanics and this scarcity quickly grew to alarming proportions following the declaration of war.

Men from every walk of life had been drawn into shops and factories, most of them to begin at the bottom as unskilled workers. Many, however, by reason of previous training in other lines, advanced rapidly to the better-paying jobs, but manufacturers, realizing the expense and delay of breaking in unskilled labor, were quick to welcome the development of outside training courses that could send them men properly instructed and trained in shop practice and methods.

In Detroit, where the shortage of machine men mounted into the thousands, national attention was attracted to the work being done by the Detroit Institute of Technology, the department of education of the Detroit Y. M. C. A. At the head of this work as chancellor of the Detroit Institute of Technology was Benjamin D. Edwards, a man keenly alive to changing conditions and the educational needs of the times, under whose direction and guidance the annual enrollment of the Detroit Tech had grown to over 3000 students.

His foresight had been largely responsible for the favorable action of the board of trustees, which resulted in the construction and equipment of a shop and laboratory building representing a cost of approximately $300,000. This building, thoroughly modern and planned particularly for technical instruction, was ready early in the spring of 1917. Hardly had the war started when steps were taken to offer a complete course in machine-shop practice. A full equipment of new standard machines was installed and competent instructors engaged.

In the working out of the course of instruction the advice and coöperation of production managers of many of the leading Detroit industries were easily secured, with the result that students completing the course found immediate and desirable employment in places they were best fitted to fill. As the course grew in popularity additional equipment had to be secured, and for this the institute found it easy to obtain Government priority orders, which in effect amounted to official recognition of the importance of the work being done.

The equipment consisted of 27 lathes, 3 shaping machines, 4 milling machines, 2 drilling machines, 3 tool- and 1 cutter-grinding machines, all installed in a light, well-ventilated room 40 x 90 ft. in dimensions. A view of the shop is presented herewith.

Eight Weeks' Course

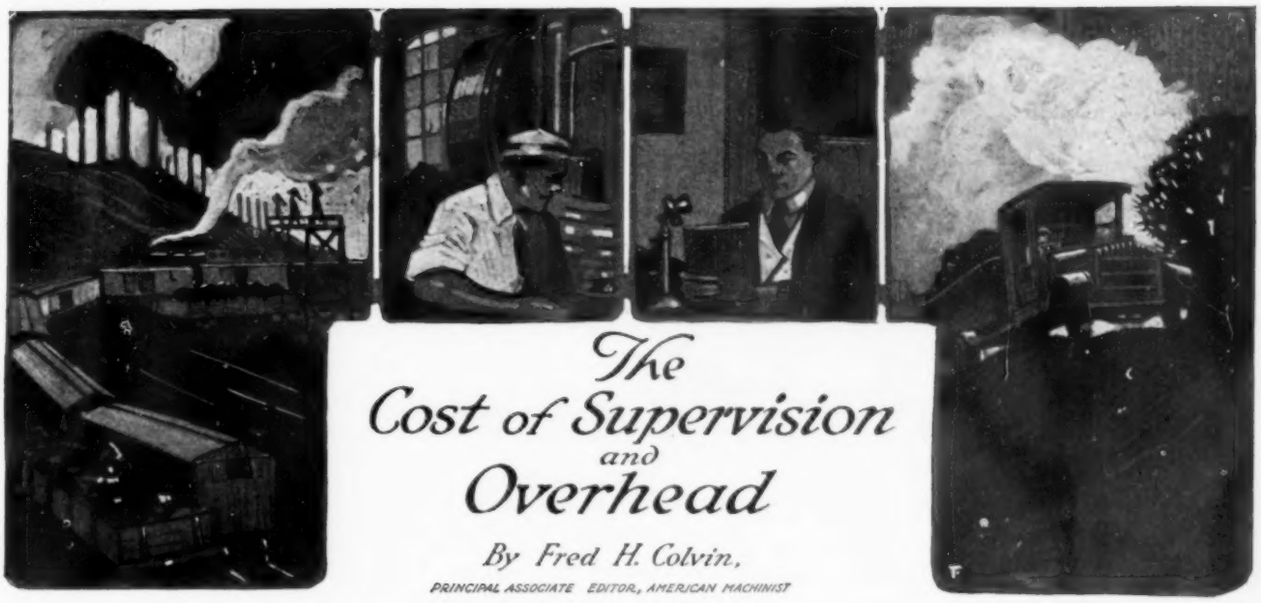
The complete machine-shop course extended over a period of eight weeks, eight hours a day, five and one-half days a week. It gave thorough instruction in the use of all the above-mentioned machines as well as bench work, tempering and hardening of tools, instruction in shop mathematics and the reading of drawings.

The time on the machines is charted and the record shows better than 90 per cent. efficiency for both day and evening. In a little less than 18 months over 750 men were graduated.

A course in toolmaking was opened to skilled machinists and to graduates of the machine-shop course. The growth and development of the work soon justified the belief that this department had an assured future.

Among the other activities of the Detroit Tech, which have contributed to the work of training men for useful service, might be mentioned the complete courses in automobile, motor truck and tractor, electrical and mechanical engineering, pharmacy and chemistry, and radio-telegraphy.

MACHINE SHOP OF DETROIT INSTITUTE OF TECHNOLOGY



The Cost of Supervision and Overhead

By Fred H. Colvin,
PRINCIPAL ASSOCIATE EDITOR, AMERICAN MACHINIST

Misunderstandings are probably at the bottom of more racial, domestic and labor troubles than anything else. These are aided by suspicions and jealousies of various kinds, and if left with no attempt at explanation or reconciliation, may easily lead to disaster. Exaggerated ideas of profits come from a lack of knowledge concerning the cost of supervision and other overhead expenses. Hence this summary of numerous inquiries which contain many suggestions.

IN THE days of the small shop there were fewer problems of every kind than face us today. The owner very often worked in the shop and the cost of supervision was almost negligible, as everyone but the apprentice could handle any job and usually needed neither instruction nor watching. The overhead cost could practically be summed up as shop rent and taxes, and these were as well known to the men in the shop as to the proprietor. Every man felt a proprietary interest in his machine and in his job, just as did the locomotive engineer of 40 years ago.

The growth of the industry changed all this. The element of personality disappeared and the absentee board of directors, like the absentee landlord, neither understood the problems of the men nor had their sympathy in any way. The old-time loyalty is almost impossible under such circumstances.

The newer type of manager, who had never been in direct contact with the shop, evidently did not appreciate the interest of the older men in their work. These managers adopted the attitude that as long as the men were paid regularly and at the prevailing rate, they had no interest in anything beyond; in fact, that nothing else was any of their business. Coupled with this attitude came the advent of the huge combinations of business, many of them with capital stock full of water, of ostentatious display of wealth and other apparent evidences of huge profits.

The men in the shop knew the cost of materials and of labor. Few of them, however, had reason to understand and to appreciate the increase in overhead expenses due to the changed shop conditions. The advent of the unskilled man on sub-operation work added new problems in supervision and also added much to the overhead expense, and in this way offset, to some extent, the decreased cost of production due to the newer method. No attempt was made, however, to show this change in cost distribution to the men in the shop, and they naturally failed to grasp the great increase in the cost of supervision.

While these huge combinations did not invade the machine-tool industry to any great extent, the influence has naturally been reflected in the minds of the men, so that many believe that it has become advisable for all manufacturers to explain matters to their employees and to show the various costs which go toward making up a modern business.

The change in selling methods, due to the necessity of keeping the huge plants going as steadily as is possible, made another addition to overhead expenses which was unknown in the old days. Then the work came to the shop as it was needed. But the marketing of huge modern production requires a sales force which costs more than was formerly dreamed of. Yet, without it, the huge shop could not keep its production up to an economical point.

Had these changes been pointed out in heart-to-heart talks with the men, they would never have obtained the exaggerated ideas of profit which have existed in many cases. Many misunderstandings could have been prevented and much greater harmony would have resulted.

There are grave questions as to how much overhead expense a business can carry legitimately, or when the cost of doing business becomes too great to warrant its continuance. There are some cases where the office in New York or Chicago employs as many people and costs more to run than the shop in which the products they sell are produced. In cases of this kind it is not surprising that the men who are actually making the product should question the kind of management or the kind of business which makes such a proportion necessary.

Much of the misunderstanding can be traced back to

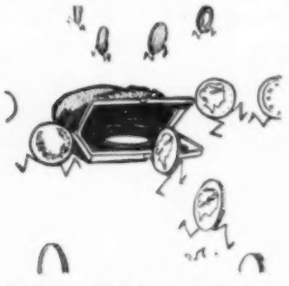
the teachings of the public schools, where, all unintentionally to be sure, children receive an entirely erroneous impression as regards costs and profits. This has been very clearly pointed out in a letter from a well-known manufacturer, who cites a well-known school example, which often reads about as follows:

"If a grocer buys a dozen oranges at 30 cents a dozen and sells them at 60 cents a dozen, what percentage of profit does he make?" The answer is, of course, 100 per cent. The damage is done by the incorrect use of the word "profit," and the child unconsciously absorbs the idea that the entire difference between cost and selling price is profit. Every business manager knows how incorrect this is.

It is to correct such impressions as these, as well as to assist managers themselves in determining the various costs which enter into the supervision of a business, that we have secured expressions of opinion on this subject from a large number of machine builders. These are for the most part given without identification, at the request of the writers, and in the hope of securing further helpful data from others. It is the growing belief of many managers that if proper methods of putting information of this kind in the hands of the men in the shop can be found, it will aid in the establishment of a better understanding, which means more harmonious relationships between the men and the management.

Where the Money Goes

In order to get something of an idea of the many items which go to make up the expenses of a manufacturing business, perhaps the outline submitted by a well-known machine tool company, of the Middle West, gives the most complete and at the same time most concise list. This divides the expenses into a number of headings as shown, and shows very clearly how the various expenses are distributed. By this method they figure the burden or factory expense as being equal to the total of the material and labor cost on a complete machine; in other words, 100 per cent.



Factory expense is divided into two parts, as shown under the heading of Supervision and Shop Management. The first division includes that of supervision and other items which are quite different in character from those in the second group under the same head. This second group includes what might be called the material things which go into the machines being built.

Fixed Charges

Taxes, buildings and real estate, material and equipment, corporation tax, capital stock, street and sewer.
Insurance.
Depreciation on equipment.
Depreciation on buildings.
Interest on investment.

Office Expense

Executive and clerical.
Depreciation on furniture and fixtures.
Heat and light.
Bonus and wage distribution.
Interest on borrowed money.
Discount charges on customers' notes.
Interest paid on notes to creditors.
Supplies—printing, stationery, etc.
Donations—charity.

Supervision and Shop Management

Factory Expense

Executive: Superintendent, production department, cost and factory clerks.
Purchasing department.
Watchmen.
Hospital.
Garage and trucks.
Discarded parts—old style.
Toolroom—manufacturing special tools and jigs; storing and distributing same.
Castings storage; receiving, storing and issuing to factory.
Blacksmith, dressing and hardening tools.
Stockroom—storing finished parts and issuing same to factory.
Steel stock storage; receiving, storing and issuing to factory.
Shipping and boxing.
Drawing room.
Pattern shop.
Inspection department.
Millwrights and carpenters.

The foregoing departments each include the following expense items:

Fixed charges.
Power, heat and light.
Labor.
Charges by other departments.
Defective workmanship.
Repairs.
Bonus and wage distribution.

The monthly total of the entire general expense is distributed on a productive-hour basis and charged as such to each productive department.

The productive departments are classified as follows:

Boring and chucking.
Lathes.
Grinding.
Polishing.
Large erecting.
Drilling.
Milling.
Planing.
Painting.
Small lathe erecting.
Milling-machine erecting.
Automatic screw machines.
Rack-cutting and keyseating.
Cutter grinder assembling.
Countershaft assembling.
Boring mills.
Gear cutters.
Repair department.
Unit assembling.

The above include the following expense items:

Fixed charges.
Power, heat and light.
Nonproductive labor—foreman and assistants.
Charges by other departments.
Defective workmanship.
Supplies.
Repairs.
Bonus and wage distribution.

Total department expense is distributed on a department productive-hour basis, and by adding the general factory expense hourly rate we have the complete hourly burden rate.

Selling Expense

Fixed charges.
Executive and clerical.
Bonus and wage distribution.
Discount allowed customers.
Collection charges on discounted notes and checks.
Entertaining.
Club dues.
Traveling expense.
Publications.
Catalogs and circulars.
Freight and drayage.

Selling expense is added to the total cost. The burden (or factory expense) on a complete machine is equal to the total material and labor cost on same.

In addition, the manufacturer pays, this year, an excess-profits tax which in large concerns is about 75 per cent.

Taxes Make Overhead 200 Per Cent.

The second concern reports, according to figures recently compiled for 1918 operations, "Our overhead was almost double the average hourly rate of shop employees. This, of course, was largely due to the tremendous income tax which the form of our organization imposed on us last year."

Firm No. 3 writes as follows: "We figure the cost of supervision in shop management as two separate burdens; one called the manufacturing expense and the other the commercial and sales burden. The kind of accounts that are carried under each of these heads would be those naturally suggested by the titles.

"The total manufacturing expense for the month is divided by the total number of productive hours for a month and the results given as a productive hourly burden rate.

"We do not consider this necessarily the best or most accurate method, inasmuch as it throws the cost of handling of raw material into the productive operation. It is, however, the method which was instituted here some time ago and we continue it for the sake of comparisons with past records, and it works out very satisfactorily. The sales and commercial burden is estimated as a percentage of the cost of sales. Both of these burdens are subject to considerable fluctuation and for the sake of obtaining more practical comparisons, we are in the habit of establishing a fixed burden for a period of six months and then adjusting it to take care of an excess or deficiency which may have accrued."

Need of Understanding

No. 4 says: "I quite agree that the question of management and supervision is perhaps the one phase which is least understood by the average worker. I also believe that a certain amount of educational work along these lines would prove interesting and helpful, for I cannot help feel that if the average worker really understood more fully and definitely the many and varied business perplexities which daily confront the manufacturer, it could not fail to have a beneficial effect on their relations. It is a fact that very few workers have the slightest conception of what the word 'overhead' means when applied to the cost of manufacturing, and it is also to be deplored that so many manufacturers seem to have so little idea as to what does or what should constitute their overhead.

"In the old days, 'overhead' was not a very common term. In fact, 'operating' expenses or 'running' expenses were the terms employed. But after the so-called efficiency engineers began to permeate the country, a good many new terms and phrases (both English and profane) seemed to come into being, and overhead was one of the more expressive, which has in too many cases been badly overworked.

Cost of Departmental Supervision

"Naturally, the cost of supervision is but one item that goes to make up what is known as overhead. In the matter of supervision, it is our practice to handle the cost in such a way that the expense of supervision of one department does not add to or detract from the expense of any other department. Of course, in the final analysis the cost of supervision goes in the general item of operating expenses. To this is added all items of general expense, such as insurance, taxes, interest on capital, advertising, and all nonproductive labor that is not directly or indirectly associated with the factory cost of production.

"In the old days it was considered almost a crime if the factory superintendent did nothing but superintend. He was expected, not only by his men but by the management as well, to turn out a full day's work, and the superintendent was usually recognizable from his over-soiled appearance, being always the dirtiest one of the bunch. It was, however, finally discovered that a superintendent could greatly increase production by spending all of his time in directing the operations of others and by using his brains instead of his hands in the direction of better methods for production.

"It was later found desirable to divide the work into departments, to analyze the cost of production in each department, and in fact, to systematize methods, and, through efficient department foremen, carry on a system of continuous study for betterment in all directions toward an increased production of better quality. In every case where modern methods of shop supervision have been introduced, production has been bettered and increased, while the overhead has been very greatly reduced as compared with the proportionate increase of production.

Advantage of Better Working Conditions

"In line with an increased production comes the matter of better working conditions and the welfare of the worker, for we cannot fail to recognize that we can all accomplish more and better work under proper conditions of light, cleanliness and order. Consequently, we endeavor to maintain the most sanitary, light and healthful atmosphere in and about our works and offices. The maintenance of such conditions adds to the over-

head, but we find that it helps to produce a better product and stimulates production to a degree that more than compensates for the expense.

"I have known manufacturers who inventoried their plant year after year as a constant factor. Every machine was inventoried at its original cost, regardless of its years of service, no depreciation being figured. Their yearly sales, with cash on hand or deposit added to the inventory, constituted their gross worth. By deducting their running expenses, which included supervision, taxes and insurance, it produced their net worth, and their year's profit was figured as the amount of money on deposit over and above what was on hand at the same period in the previous year.

"These manufacturers still have 'working foremen' and are unable to understand how a superintendent or foreman who does not produce with his hands can be of any real service. Of course, in such firms the general manager always does the shipping and invoicing in order to earn his wages and to insure that no mistakes are made! Fortunately, these firms are growing less in number, but the real overhead of these firms is considerably in excess of that of a modernized works with proper supervision.

Relieve Workers of Clerical Duties

"It is our practice to relieve the worker from all clerical work so that each man's time and attention can be devoted to production without having to disturb himself several times each day in trying to figure out whether he put in three hours on the last job and an hour and a half on the job before. We issue work tickets from our factory office by means of a pneumatic tube system connected with each department, and by which work 'move' tickets and all other departmental instructions are issued, so that the worker is enabled to keep his mind on production.

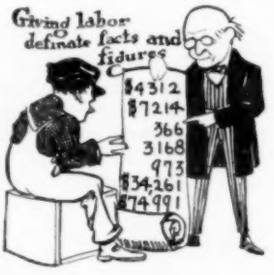
"This, of course, adds to the overhead, but not in proportion to the time that it saves the workers and the increased production effected thereby. Anything that will save time, add to the betterment of working conditions, remove complication and detail, is a factor in the contentment of the worker. It adds to his efficiency, insures a better product and an increased production in a measure beyond the extra burden to the overhead which such betterment incurs.

"As to the cost of supervision, we divide up our overhead under four different items. These are Factory Burden, Commercial Burden, Direct Labor, and Material. These for the past year show about as follows: Factory Burden, 45.8 per cent.; Commercial Burden, 6.3 per cent.; Direct Labor, 17.4 per cent., and Material 30.5 per cent."

Believes in Giving Facts and Figures

No. 5 writes: "We hope that managers and executives will realize the necessity of carrying on educational work among their own employees so as to give labor in general some definite facts and figures regarding the cost of doing business.

"The writer believes that a considerable amount of the present unrest in the industrial situation is caused by ignorance on the part of the average shop worker regarding the cost of supervision and other necessary expenses, these expenses being always necessary to hold an organization together and to procure work for which wages may be paid.



"As a general proposition, we believe that almost any management will be benefited by taking the workers into their confidence and explaining the items making up the cost of overhead. If this is done in some simple form so that the workers will at least grasp the fundamental principles, we believe that they will clearly understand that all between the cost of material plus direct labor and selling price is not profit.

"The writer has even met intelligent foremen who did not have any clear conception of overhead expense or of the way in which this expense must be taken care of, so that a profit can be insured for the capital invested. We believe also that some additional benefit would be derived in letting the workers know about the actual cost of the materials they use or waste, and the first cost and subsequent expense for repairs of the equipment which is provided for them. For without this they would be unable to exercise their skill and thus secure any income."

Where Labor Cost Is High

No. 6 is from a shop building small machine tools, and says: "As the machinery we build is of small size, the labor cost is by far the largest item. As our men are all paid on the hourly basis, we have taken the productive hour as the basis of all our overhead charges.

In other words, we have recorded the number of hours that our productive men have charged in during the past year and have then divided the factory burden, which includes the non-productive labor, all supplies used in the manufacture of the machines but which do not enter into their construction, depreciation on buildings, machinery, tools, patterns, and drawings, insurance, light, power, heat, repairs and renewals to the buildings, cartage, freight, express and taxes. This, we find, amounts to 13½ cents per hour.

"In addition to this, we have figured the sales expense, including in it the general and office expense, advertising, commissions, and items of a like nature. This amounts to 6½ cents per hour and makes a total of 20 cents to be added to each hour of productive labor required in the manufacture of a machine. We consider that this 20 cents multiplied by the number of hours used in producing a machine, added to the actual wages paid to the men and to the cost of materials, represents the total cost, and that this is the least which must be obtained for the machine to insure against actual loss.

"The profit on the transaction should include the interest on the capital invested and the salaries of the proprietors if they are actively engaged. In order to

allow for expansion of the business, a larger profit than this must be allowed for."

High Wages but Lower Labor Costs

Among the most interesting figures are those obtained in letter No. 7, which, after indorsing the plan for the distribution of real knowledge concerning costs of production, gave an excellent summary of their own distribution of costs during the years 1913, 1914, 1917 and 1918. These are shown in the following table and should be extremely valuable as a means of comparison, as this is a modern shop and one which is recognized as being well managed.

COST OF PRODUCT IN PERCENTAGE

	1913	1914	1917	1918
Material	0.2512	0.1695	0.3847	0.3471
Productive labor	0.2233	0.1735	0.1937	0.1649
Burden or shop overhead	0.4086	0.4781	0.3708	0.3615
Commercial cost	0.1167	0.1781	0.0507	0.1264

It is particularly interesting to note the difference in the percentages of the various items during the different years. Material, mostly cast iron in this case, fell from approximately 25 per cent. of the total cost in 1913 to 17 per cent. in 1914, but jumped to over 38 per cent. in 1917. This was during the time of $55 pig iron. When the price was controlled by the War Industries Board the cost of material dropped to less than 35 per cent.

Productive labor was less in 1914 than in 1913, and though it increased slightly in 1917, the lowest cost is in 1918, when wages were higher than at any other time. This speaks particularly well for the productive methods and probably for the coöperation secured in the shop. It is also interesting to note that the burden or overhead expense was lower than at any previous time, this being particularly high in 1914. Commercial or selling costs were extremely low in 1917, due to practically the entire product being absorbed or at least allocated by the Governmental activities.

Firm No. 8 expresses its approval of the publication of facts concerning the amount of overhead, saying: "The average workman has no appreciation of the cost of doing business and also an exaggerated notion as to profits. We believe that if the returns of corporations, which are open to the public in Massachusetts and other states, were carefully studied, they would show that for a long term of years profits did not average nearly as much as was popularly supposed.

"Our own cost-account system is very common. We keep the total of the productive hours in each department, find out weekly the total of the various items of overhead expenses, and divide this by the number of productive hours, then distribute the cost of the overhead to the various jobs in accordance with the number of productive hours on that chart. The cents per hour will, of course, vary according to the number of productive hours at which the shop is running. Our present figures are somewhat over the normal, due to the fact that we have been doing an unusual amount of repairing which we have charged to this account.

"Having established our manufacturing costs, we keep the cost of selling and of general administrative expense for each group of the articles we manufacture. This total we distribute as a percentage on sales in the corresponding department.

"Certain fixed items as, for example, a requisite return for capital, are somewhat beyond the control of the men. For without a return of say 6 per cent. on the investment, there would be no capital for expansion or extension of the business.

"The matter of taxation is one in which all workmen have a part, and it is a matter of good citizenship for every voter to see that the money raised in taxes is properly spent. City taxes in our case amount to about ½ cent an hour on productive labor, state taxes perhaps ¼ cent, and the Federal taxes about 2 cents per productive hour. This should make it evident that any extravagance in government leaves less money for the development of the business or to be distributed between those who invest and those who directly produce the work of the shop.

"We believe that there should be a frank understanding as to the costs of doing business and that an effort should be made to have the men realize that the responsibility for results is partly theirs. Anything which can bring about a better understanding of the problems on both sides cannot fail to make for more harmonious relations and better returns to all concerned."

These firms represent a wide variety of machine manufacture and the figures given may be considered to give a fair average for present conditions. It is almost universally suggested that the facts about shop costs should be made clear to the workmen. Clearly written bulletins or posters may be the best method of doing this.

An Easily Made Sine Bar

By E. Amos

On page 1097 of the *American Machinist*, J. B. Gray describes his way of making a sine bar and criticizes John Teckeer's method, outlined on page 260, of making the same tool on the ground that difficulty would be experienced in attaining the high degree of accuracy necessary in such a tool.

It would seem to me that there is little choice between the two in that respect. As Mr. Gray says of his design the surfaces *A* and *B* must be ground at the same setting in order that they may be parallel; but a great deal more than grinding at the same setting is necessary to insure parallelism to within 0.001 in. It is also necessary that the surface upon which the buttons rest shall be parallel with its opposite face and that both be absolutely square with *A* and *B*.

It is necessary also that the ends of the buttons be square with their surfaces, which condition is by no means assured by the fact that the buttons are bought at a hardware store.

Then, too, while it is possible to get the buttons in contact with surface *B* and keep them there while tightening the little screws that hold them, it is likewise possible and even easy to move them 0.0001 in. or more either in tightening them or subsequently.

I believe in sines myself, but I realize the necessity of keeping close tabs on them to see that they do not play tricks on me. It is not pleasant after finishing a job with dimensions to the fourth decimal place to have a hard-hearted inspector come around and tell you that your sine bar is 'steen millionths out of whack according to the meridian of Greenwich.

The Riddle of Dependency—II

By CHESLA C. SHERLOCK

AS WAS pointed out in the previous discussion, there are in this country two classes of dependents; those conclusively presumed by law to have been dependent upon the earnings of the deceased workman for support, and those who must establish their dependency as a matter of fact. In treating of the subject of who are dependent, we will first consider those who are generally conclusively presumed to be dependents, or those who are specifically enumerated in the statutes as being entitled to compensation as dependents.

It might be noted here, however, that since the American acts have attempted to classify dependents in the statute itself, any person who is mentioned in such classification is not entitled to compensation as a dependent. Do not misunderstand this statement, for the acts are generally very thorough in the classification, not only classifying those who are conclusively presumed to be dependents, but also those who may be partial or total dependents upon a finding of fact to that effect. Where the acts specifically set out the persons entitled to compensation, either upon a presumption of law or upon the establishment of fact, and practically all of the acts do, it is obligatory upon the employer to consult that act in ascertaining who are dependents.

We will, however, discuss the matter in connection with the decisions which have already been rendered by the proper authorities under the classifications of relationship usually found in the statutes.

The New Jersey court has said that proof that the deceased workman gave his earnings to his father up to and prior to the time of his death, and that the father had no other means of support or income, was sufficient to justify a finding that the father was a dependent of the son.

In Ohio, it was held that an invalid father was wholly dependent upon the earnings of the deceased son.

It has been held in a number of cases that a father may be found to have been dependent upon a deceased son but that such findings cannot be made as a matter of law, but must depend upon the facts in each case. The mere fact that there was a moral obligation to support, or that the deceased intended to furnish support shortly, is not sufficient establishment of the status of dependency.

In other cases, the point has been brought out that it is not necessary for the father to show that he is under or was under absolute necessity for his son's earnings in order to live. It is not necessary that actual necessity for the son's contributions be shown, but the mere fact that such contributions were made and were used in supporting the father will generally be deemed sufficient.

In other cases, it has been held that a showing of the fact that the father received money from the deceased son and spent it is not sufficient to establish dependency; this is a point worth remembering. If such money, when received, was used for purposes other than buying the necessities of life or in the actual support of the father, no dependency has been established. Again if the money received is insufficient in amount to show dependency, even in a partial way, then no case has been established and the employer will not be required to pay compensation to the father as a dependent.

What are Dependents?

According to our compensation acts there are certain persons whose dependency is "conclusively presumed" and who have only to establish their relationship to the deceased workman to obtain compensation. Others must prove their dependency in order to recover. Do you know into which class any particular case would fall?

In a Massachusetts case, it has been held that where a minor son contributes all of his earnings to his father, the extent of the father's dependency is not diminished by the fact that the father pays for the son's support. In other words, the employer is not entitled to deduct the amount of the son's support from the amount of wages contributed to the father. This rule, doubtless, would be the exact opposite in cases where the son was not a minor, and indeed it has so been held in a number of instances.

In an English case, it was shown that a minor son contributed his wages to his father, but that the wages were not more than the value of the son's support; that in addition the son rendered services to his father in his spare time which had some value. The court held that the value of such services should be taken into consideration together with the cost of his maintenance.

In another English case, it was shown that the deceased son had contributed largely to the support of his father, paying the house rent and also a large portion of the other expenses, but that the father who had an irregular earning capacity had been supporting, in addition, another brother who was crippled. At the death of the workman he was unable to continue his house. The court held that the father was at least partly dependent upon his son regardless of the fact that he, himself, was supporting another person.

It has also been held in an English case that one cannot be deemed the dependent of an illegitimate son of the wife. It was shown that the claimant had married the mother of an illegitimate son, he not being the putative father, and that all three had lived together, the son contributing his wages toward the expenses of the household. The court held that the husband was not a dependent of such an illegitimate son within the meaning of the English compensation act. A similar ruling would doubtless obtain in this country.

The effect of the decisions, then, is to show that there is nothing to prevent a father of the deceased workman obtaining compensation as a dependent, provided such dependency actually existed at the time of the accident.

It is quite generally provided in the various statutes that the mother of a deceased workman shall recover compensation, either as a partial or total dependent, according to the degree of dependency as brought out by the evidence. The real question involved in regard

to the mother of the decedent is generally found not to be as to whether dependency existed, but as to the degree thereof, it usually being fairly well presumed that some sort of a dependency exists in such a relationship.

It was held, in an Illinois case, that where it is shown that the mother had no property and that the deceased and his sisters had taken care of her, all keeping house together, there was sufficient evidence to show dependency.

In an Illinois case, it was contended that such contributions as the son had made to his mother were not in the nature of contributions for support, but merely holiday or birthday gifts. The court ruled, however, that in the absence of an express showing involving the intent of the deceased in making the gifts, that they would be presumed to have been made for support, and that dependency would therefore be established to the extent of the contributions.

Another Ohio Case

In another Ohio case, there was evidence to show that a deceased daughter had been turning over the greater portion of her wages to her mother, as did other wage-earning members of the family, and that the mother then used the money to meet the household expenses. It was held by the Industrial Commission that this was sufficient to show that the mother was at least a partial dependent of the deceased daughter.

In an English case, it was shown that a workman had been in the habit of sending weekly contributions to his mother and that for a certain length of time he had sent a certain amount regularly. Upon changing his employment he sustained an accident causing death. It was shown that up to the time of his death he had made no contribution to his mother. The court, however, held that the evidence was sufficient to establish dependency, leading one to presume that he would have continued such contributions had he lived.

In this connection, it might be well for employers to note that a mere change of employment will not relieve an employer of the liability of paying compensation to dependents, provided compensation would have been due to the injured workman himself had he lived. The employer who is employing the man at the time of accident is liable, and the present behavior of the workman is not the true criterion of dependency liability, but the past record of the deceased governs.

The Wisconsin commission has held, in conformity with a decision mentioned in connection with the dependency of a father, that where a minor son contributes his earnings to a mother who supports him out of those earnings as well as herself, that the extent of dependency cannot be ascertained by first deducting the value of that support, but that the extent of the dependency is based upon the total earnings of the deceased. In other words, it is not permissible for employers to deduct the value of the support of minor children from the compensation which they are to pay dependent parents, the law presuming that the extent of dependency is the same as the full value of the contributions made by the deceased.

The mere fact that a son leaves a widow does not ordinarily affect the dependency claim of a mother who is an actual dependent upon him. Most of the statutes provide the amount of compensation which a parent may recover in such cases, and in New Jersey it is fixed at 25 per cent. The court of that state sustained an award in that amount to a dependent mother, saying that the payment should be made without regard to whether the son left a widow or not.

In another New Jersey case, it was urged that since the law made no mention of such a case, where a deceased workman left a mother, but no widow, the mother could not recover any compensation.

What the Court Said

Said the court: "It would be absurd to construe the act, which by its very language secures compensation to actual dependents in such a way as to give that compensation to more remote relatives and not to near relatives. We can think of no reason that would justify such an exclusion. That it was not intended is indicated by the fact that express provision is made for the father or mother where there is a widow. The legislature cannot have meant to provide compensation where the decedent was under the double obligation to wife and parent and to deny it when he was only under the single obligation to father or mother."

In Illinois, it was held that where the deceased workman left a dependent mother and nondependent brothers and sisters that the compensation was payable to the mother alone and not to the brothers and sisters also.

In this connection it is well to note that a stepmother may receive compensation as the dependent of a deceased workman the same as his actual mother might, the sole question going to the facts in the case. The test in dependency is never a test of relationship, as it might be if dependents stood in the same position as beneficiaries, but the test is the fact of actual dependency, either in whole or part, and where the facts establish such actual dependency, a stepmother will have as much right to the compensation as an actual mother in the same circumstances would have. Of course, there is no test to apply where the statute establishes a legal presumption of dependency in the case of a mother, such dependency being established by relationship in that instance.

The wife is generally conclusively presumed by the statutes to be a dependent on the husband, provided they were living together at the time of the accident causing the husband's death. It is seldom that the dependency of the wife rests upon a question of fact, unless it be as to whether the parties were "living together" within the meaning of the statute.

In Wisconsin, it has been held that this question is one of fact to be determined by the Industrial Commission, as are all other questions of fact.

In a Massachusetts case, it was held that where the wife and children of the deceased were living apart from him at the time of his death, there is no conclusive presumption that they were dependent upon him for support, but that it is a question of fact to be decided by the evidence in the case.

The greatest disagreement in the case of dependency of the wife arises where she was living apart from the husband at the time of the accident. As to where there has been a separation of the parties, many questions of interest and profit to employers arise. If the separation is the fault of the husband and he has been compelled by court order to contribute toward the support of the wife, compensation will be payable to her as a dependent.

In a Scottish case, it was held that where the separa-

tion was due to the wife, where she had voluntarily withdrawn from the husband's household more than 12 years before his death and had supported herself from her own earnings, that it could not be held that she was the dependent wife of such workman and compensation was denied her.

In an English case, it was shown that the wife had voluntarily separated herself and her children from the husband and had never received any support whatever from the husband, although it was shown that he had repeatedly offered to aid in their support, but such offer had been refused. The court said that in view of these circumstances there was no dependency and that no compensation should be paid by the employer.

In still another case, it was shown that the husband and wife had voluntarily agreed to separate, the wife being supported by an illegitimate son. It has shown that this separation occurred more than 11 years prior to the death of the husband and that during that time they had met only casually, three times in all, but that on each occasion the wife had received small sums of money from the husband. It was held that these contributions established no evidence of dependency.

The mere fact that the parties are separated at the time of the death of the workman is not sufficient to deny the wife compensation as a dependent even under the wording of the American compensation acts.

(*To be continued*)

Necessity for Keeping Grinding Wheels In Perfect Balance

By John H. Peckham
The Norton Grinding Co.

This brief paper is written with the idea of reaching users of grinding wheels and machines that they may know the real necessity of having wheels in perfect balance at all times, to insure precision grinding and to produce highest quality of work and production at the minimum cost.

During 30 years' development in grinding machines engineers have spent unlimited time and money to perfect those of the present. They have realized and tried to impress upon their customers through untiring efforts that if they expect the machine to be a success the wheel must be in balance.

An unbalanced wheel causes chatter marks on the work, causes the wheel to pound, wear unevenly, and breaks up the face, making it wear very rapidly. It also requires frequent dressing and truing with the diamond, with the result that the diamond cost is excessive.

For example: An 18-in. diameter wheel 1 oz. out of balance, running 1360 r.p.m. on a 10 x 36-in. Norton cylindrical grinding machine, exerts a force of about 25 lb. every revolution, and will produce vibration in the machine, which is reproduced on the work. The continual pounding in the spindle boxes will in short time wear the boxes and spindle egg-shaped.

With these conditions existing the operator not only imperils his life as well as that of nearby fellow-workmen, but finally accomplishes the destruction of spindle boxes and gets unsatisfactory work.

Can you imagine standing before a grinding wheel running between 6000 and 6500 surface feet per minute and having the wheel break? To be sure, adequate safety hoods and guards are in vogue, but there is a'ways danger. Of all evils mentioned heretofore this one alone should, for the protection of life and limb, be considered first.

Customers have in many instances believed that the gears in the headstock caused chatter marks, but in practice nine cases out of every ten have proved the wheel to be out of balance.

Never tighten spindle boxes to overcome chatter marks. The procedure may help the condition but it will never eliminate it. Put the grinding wheel in static balance from time to time. Note the Norton cast-iron balancing center, with lead inserts for putting the wheel in balance, shown in the cut.

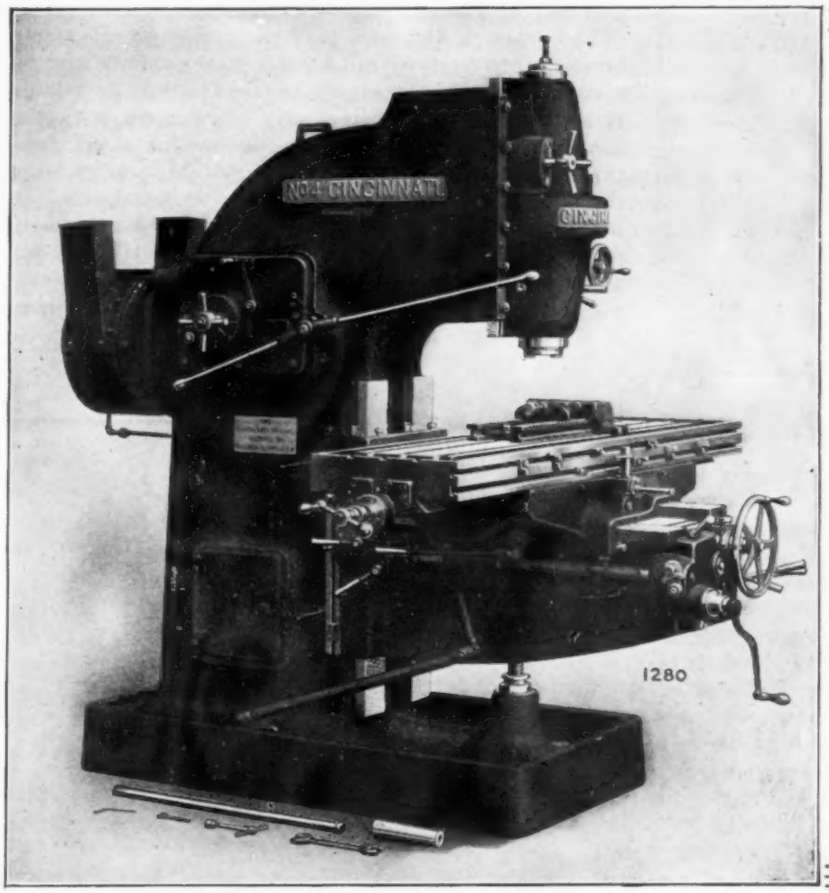
Place the wheel on a balancing arbor and the arbor on a balancing stand having knife edges, making sure that the stand is accurately leveled in both directions

BALANCING A GRINDING WHEEL

to insure accuracy of balance. Proceed to move the lead inserts relative to each other, until the wheel can be placed at any point on the knife edges and balance itself.

The periphery of the wheel balanced with weights in proper places will produce good work until the wheel has been reduced by wear about 1 in. For example: When a wheel 18 in. in diameter has been reduced to 17 in., it should again be balanced. As the wheel is reduced in diameter from time to time the lead weights must be shifted in their relative positions to insure best results.

A wheel in balance at all times reduces the diamond consumption and wheel wear beyond conception, and the user of grinding machines and wheels will, by properly attending to this matter, secure four important results: Safety for the operator, accuracy, production and good work, while the time employed in balancing wheels will save many dollars worth of diamonds and wheels.



The No 4 Cincinnati Vertical High-Power Milling Machine

Special Correspondence

As a result of the success attained by the new No. 5 high-power horizontal type Cincinnati milling machine, described on page 971 of the "American Machinist," the Cincinnati Milling Machine Co., Cincinnati, Ohio, has placed on the market a heavy vertical machine of similar design, embodying some of the same features. This new machine is intended for extremely heavy work and is patterned after the No. 5 in all those elements which are common to both machines.

FOR die work, some classes of toolroom work and many manufacturing operations, the vertical-spindle milling machine has many obvious advantages over a machine of horizontal type. Chucking the work, in particular, is often simpler and the work is more accessible and very easily observed. Also, in combination with a rotary milling attachment the vertical-spindle machine becomes a continuous milling machine. The stresses set up by the cutter in the vertical machine, particularly when using the large-diameter face mills for which this machine is designed, are just as severe as those which must be taken by the horizontal machine of the same horsepower rating. However, horizontal machines are provided with braces for tying the upper part of the machine carrying the cutter, and the knee which carries the table and the work, together. There is no such provision on a vertical machine and the stresses must be absorbed by the knee and column and those parts must therefore be made very strong and solid to take heavy cuts at high rates of feed. The illustration, Fig. 1, will indicate that the column of this new machine has unusually great depth and width, the walls being thick and well ribbed.

The Construction of the Knee

The knee is the other member which must absorb these same stresses and also carry the entire load of the table, saddle, fixture and the work. It is shown in Fig. 2, which illustrates the size of this member as well as the thickness of its walls, and the extent to which it is ribbed. The openings are small and are placed as far as possible in the neutral sections. It is connected to the column by rectangular bearings with square gibs and narrow guides which, together with the rigid construction of the knee itself, provide ample strength for the maximum cuts and heaviest load this large machine is designed to carry.

The saddle is long and its extreme width provides an ample bearing for the table. Its bearings on the knee are again rectangular, square gibbed and with a narrow guide which provides good sliding conditions even when the table is heavily loaded, and at the end of its travel. This square gibbing also enables the incorporation of a very effective clamp for securing the saddle to the knee. This clamp is, in fact, so effective that no special stops or other facilities are required for holding the saddle in position when heavy irregular cuts are being taken. The saddle details are shown in Fig. 3, which also illustrates the liberal proportion of the feed gearing, the connection of the power quick-traverse transmission and also the connection for the drive for the circular milling attachment shown in Fig. 4. This circular attachment is also entirely new, designed in strength and general proportions to suit the machine. By using this arrangement the machine may be converted into a continuous milling machine, at the same time allowing the use of the table feed independent of the rotary feed. It also makes possible the use of the power quick traverse for both the machine table movement and for rotating the attachment table, the operator being relieved of all hand adjustments.

The table of the machine is 19 in. wide, has a working surface 68 in. long, with three T-slots ¾ in. wide, providing ample clamping facilities. In order to resist as far as possible the warping effect of clamping bolts when holding the work for heavy cuts the table has been

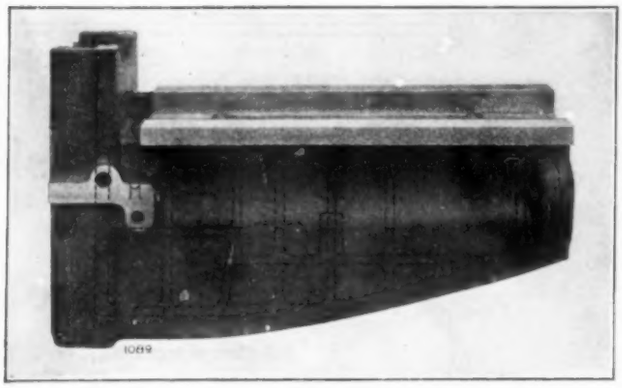


FIG. 2. VIEW SHOWING THE RUGGED CONSTRUCTION OF THE KNEE

made of unusual height, box section, and has a large number of ribs to give it added stiffness.

The main driving pulley runs on ball bearings and is mounted on a bracket fastened to the column, this method relieving the driving shaft of belt pull. It drives the machine through a large powerful friction clutch which is operated by the main starting lever from either the front or rear of the machine. When the clutch is released to stop the machine an automatic brake is engaged and stops the spindle almost instantaneously. A belt guard conforming with the modern safety laws is also provided. The main driving pulley runs at a fast speed which allows the use of a high-speed motor for either the belted or geared driving arrangements.

The Speed-Change Mechanism

The speed-changing mechanism is similar to that of the No. 5 machine except that the spindle and back gear shaft are turned to the vertical position. One of the novel features of this machine lies in the fact that this is accomplished by incorporating in the vertical machine the same large face gear and the same powerful mounting of the spindle as in the horizontal machine. The back gear shaft which is parallel with the spindle, and therefore also in a vertical position, is driven through a pair of bevel gears, and back of these the entire drive is the same as on the horizontal machine. The speed changes are made through selective sliding gears. There are no tumblers in the machine, and all shafts are hardened. The back gear shaft has four integral keys on which the back gears slide. This transfers the sliding feature from the spindle to the back gear shaft and eliminates the difficulty resulting from a construction that requires the spindle to slide through the gears.

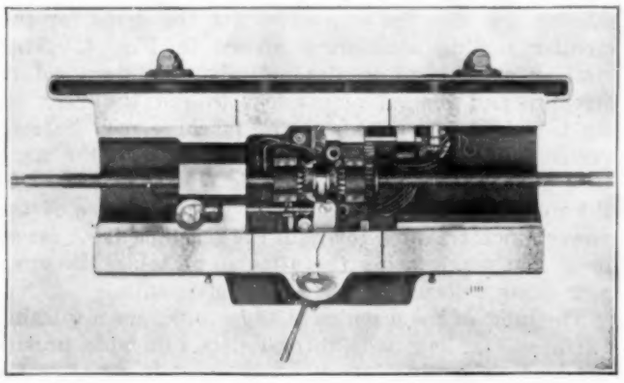


FIG. 3. DETAIL VIEW OF THE TOP OF THE SADDLE WITH THE TABLE REMOVED

The gears on the back gear shaft may be selectively brought into mesh with the gears of the spindle and no matter which set of gears is engaged, when the spindle is adjusted vertically they may slide along with the head and retain their driving engagement at all positions of the head The spindle itself has no gears on it but is surrounded by a sleeve, the lower end of which is slightly tapering and fits snugly on the spindle to which it is keyed at this point. This construction for all practical purposes makes the spindle and sleeve one piece, having the effect of merely enlarging the diameter of the spindle, and at the same time placing all stresses due to driving on the sleeve to which the face gear for the slow speeds and secondary gear for the higher series of speeds, are keyed. When the head is adjusted up and down, these gears are carried with it and there is a connection between the head and the driving gears on the back gear shaft which moves them up and down to correspond.

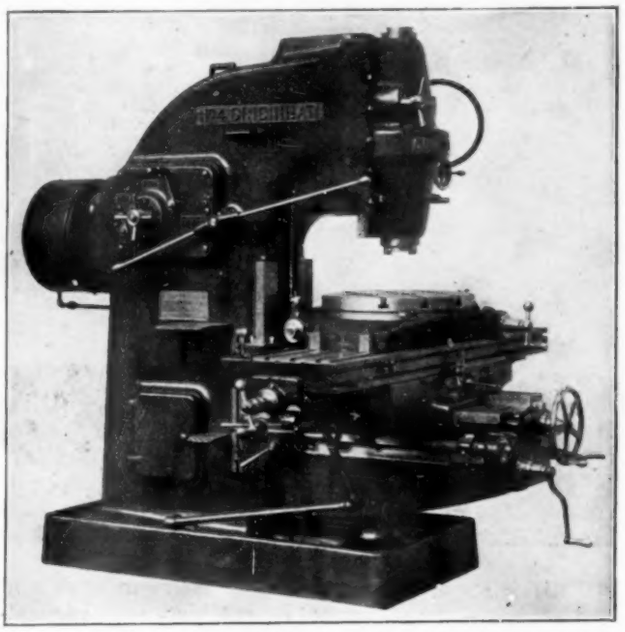


FIG. 4. MACHINE WITH THE SPINDLE HEAD LOWERED AND CIRCULAR MILLING ATTACHMENT IN PLACE

The Spindle Head

The spindle head is square gibbed to the column and carries both bearings of the spindle in fixed positions in relation to each other for all positions of the head. The quick head adjustment may be made through the pilot wheel at the right side of the column, one turn of which moves the head 6 in., the full adjustment. There is also a slow adjustment provided through a handwheel (worm and wormwheel) which is brought into engagement by means of a fine-tooth clutch operated by a knob in front of the pilot wheel. There is a micrometer stop and also a micrometer dial provided. The details of the head are shown in Fig. 5.

The feed mechanism is placed at the side of the knee and the feed changes are made through sliding gears by a single lever operated from the front. The changes may be made instantaneously from one feed to any other by merely shifting the position of this lever. Its location and the ease with which the feeds may be

changed also makes the fast feed of 30 in. per minute available as a quick traverse for cross and vertical adjustments. The standard feed range is ¾ in. to 30 in. A slower or a faster rate may be furnished.

The individual feed levers for table feed control, each of which starts, stops and reverses its corresponding feed, also at the same time indicates the direction of movement and these levers are duplicated at the rear of the machine so that the feeds can be controlled from a position behind the table when the size of the work makes this position desirable. The table feed lever has five positions controlling the starting, stopping and reversing of the table feed, and also the quick traverse of 100 in. per minute for the longitudinal movement in both directions. The trip mechanism is arranged for intermittent feed, this feature being made available by setting the necessary dogs to suit the work and the intermittent feature may be used for feeding in either direction. This feature saves much time on work in which the cut is intermittent, the fast and slow feeds being controlled entirely by dogs, automatically bringing the quick traverse into action at all times except when the feed rate is being used. This is one of the outstanding features of this new machine and is a great time saver.

One of the cycles of movement which is especially useful in the vertical machine is the continuous reciprocating cycle. The application of this cycle is as follows: Assume two pieces of work on the table some distance apart and assume the cutter in the space between the two pieces. The operator starts the machine; immediately the table moves quickly until one of the pieces has arrived at the cutter, when the dog trips to the feed rate; the work is fed under the cutter and then the table is reversed and is returned at the quick rate until the cutter arrives at the next piece, when a second dog trips to the feed rate. After this piece has been traversed the table is again reversed, and a piece which the operator has in the meantime chucked in the other fixture is again brought to the cutter and so on. This is continuous reciprocating milling, the operator chucking a piece in one fixture while the machine is milling the other, the entire operation of the machine being automatic.

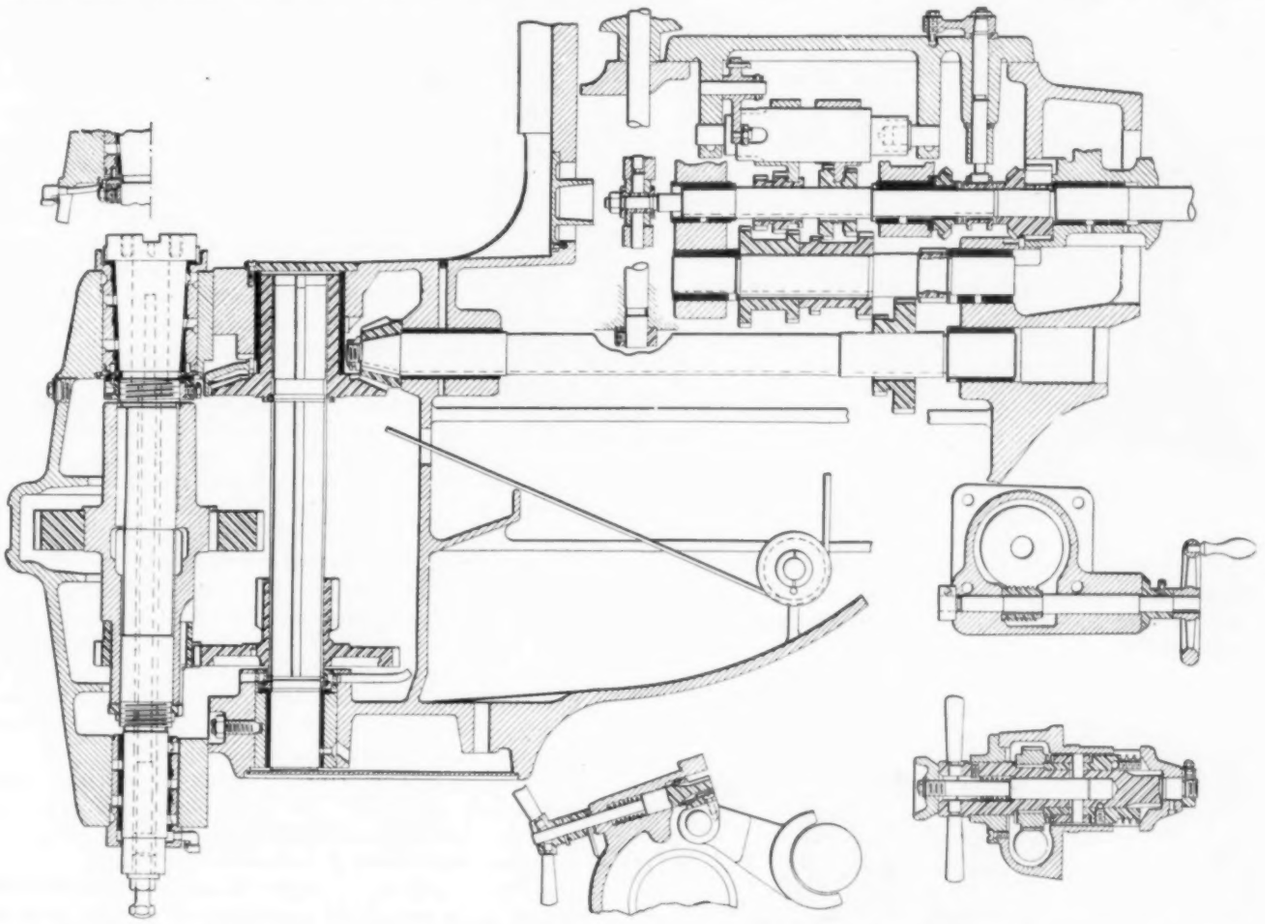


FIG. 5. A CROSS-SECTION OF THE MACHINE THROUGH THE CENTER LINE OF THE SPINDLE, TOGETHER WITH DETAILS OF THE OILING AND GEAR-SHIFTING MECHANISM

Table and Crossfeed Are Dog-Controlled

Another feature is that the table and crossfeed can be used consecutively, being dog-controlled. The design of the trip members is such that with the dog in the path of the trip-plunger, the power feed can be easily reversed and the table fed in the reverse direction, so that the work can be finished in a square or rectangular path in either direction.

A centrifugal lubricant pump with a capacity of 11 gal. per minute is supplied as regular equipment for cooling the cutters. A geared pump placed in the pulley bracket provides automatic lubrication of all mechanism in the column, and several centralized oiling stations

provide quick and convenient oiling facilities for the bearings in the knee, saddle and table. Another feature is that it is not necessary to set the table in a certain position for oiling the inside parts of the saddle and table and their bearings, as these parts may be oiled with the table in any position whatsoever.

Fig. 6 is the spindle head detached and shows the two main gears and the gear-shifting mechanism, as well as the method in which the gear assembly slides on the back gear shaft to allow for spindle-head adjustment.

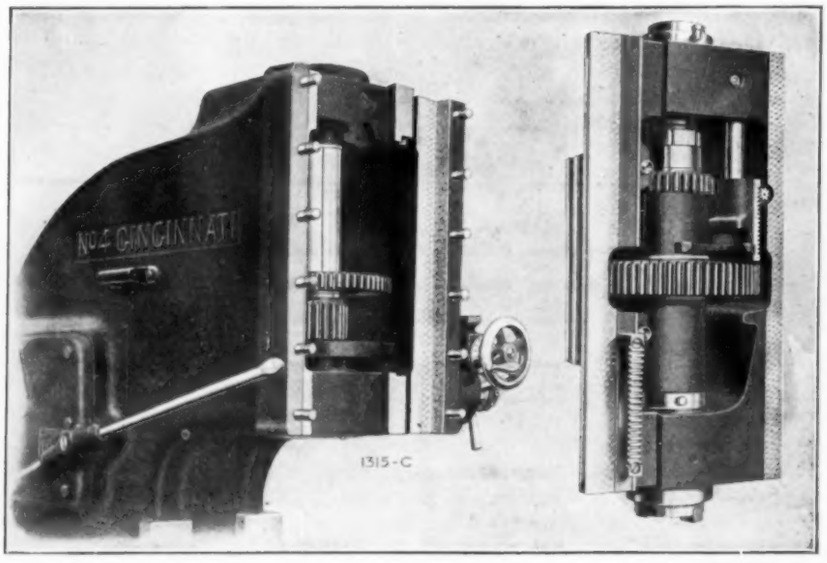


FIG. 6. SPINDLE HEAD REMOVED, SHOWING THE GEARED DRIVE

A view of the machine from the side opposite that given in Figs. 1 and 4, is shown in Fig. 7.

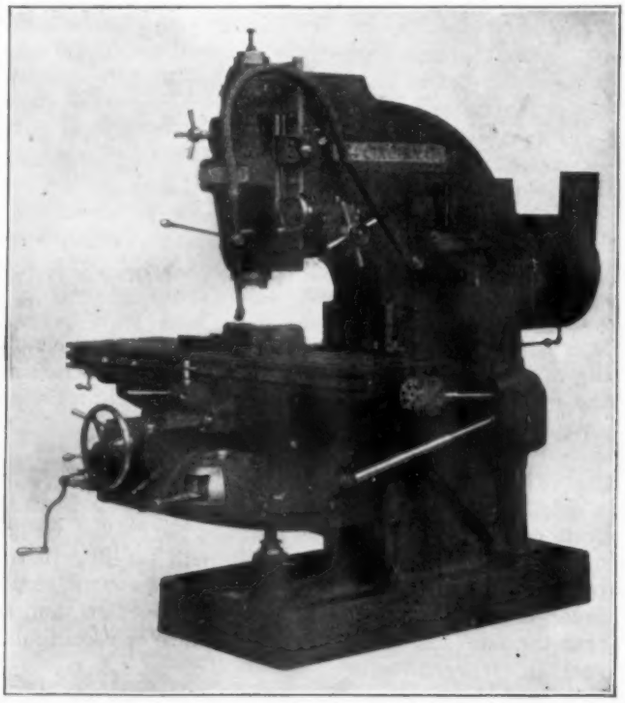


FIG. 7. MACHINE AS VIEWED FROM THE RIGHT FRONT

Size of table, 19 in. wide, 68 in. long, with three ¾-in. T-slots; driving pulley, 16 in. in diameter for 5-in. belt, running 600 r.p.m.; rapid traverse for cross and vertical adjustment, 30 in. per minute; rapid traverse of table feed, 100 in. per minute; capacity of centrifugal lubricant pump, 11 gal. per minute; weight, 9500 lb.

Centralized Compressor Plant Versus Independent Compressors

BY E. L. MILLS

I wish to take exception to the conclusions drawn by Frank Richards, under the above heading, on page 728 of *American Machinist*. He criticises the use of several compressors by the Winslow Bros. of Chicago, in their shell shop and shows the economy of a single unit which is ideal for a shop running 10 hr. a day and six days a week but not for a shell shop. The shell business was a 24-hr. day, seven days a week, job. Every minute of the time air had to be used for some purpose. Therefore the shut down of the single unit, for any reason would tie up the whole works. The best reason, however, for two or more compressors, was to provide a separate supply of air for the sand-blast In every shop this was a comparatively unknown factor. The number of shells passing per hour would vary; perhaps a series would be condemned for bad varnish and they would be added to the regular run. The greatest variable, however, was the constant wear of the nozzles. I have frequently found them $\frac{5}{8}$ to $\frac{3}{4}$ in. in diameter, but this did not worry the operators.

Now consider a single system, very ample for average conditions: Suddenly a battery of oversize nozzle sandblast machines cuts in. The first intimation of trouble is that about half of the heavy bore chucks are slipping, entailing more or less loss in production. After a few such slips the beautiful cutting surface on the outside of the shell would enlarge the jaws so that they would have to be repaired or replaced.

It is easy to say "more air," "watch the nozzles," "use larger chuck cylinders," but the practical cure was a separation of the two systems which put the penalty for low air pressure where it belonged every time.

Shell shops were got together in the shortest possible time and could not afford to wait three or four months for a large compressor if several smaller ones could be purchased off the shelf. New uses were found for air every day; blowpipes seemed to sprout and grow overnight. The best of chuck cylinder connections and pistons used several times the figured amount of air. It was a constant struggle in the earlier shops to keep up with the demand for air. This was also due in a great measure to the rapid growth in production called for by the Government and the enormous advantage of compressed air in a shop of this kind.

The later shops, or those starting during the last two years, had the advantage of the first shops' experience and probably came closer to the mark in figuring their air requirements. One of the peculiarities of this work was that there were no secrets. All were working to the same end, and while no two shops were equipped or arranged alike, any shortcut method or process was open and free to all that were in the business or expected to be.

I feel sure that the Winslow separate compressor plant was right for the reasons stated here if for no others.

Load Characteristics of Radio-Thrust Bearing

By F. W. GURNEY

This article is practically a description of the chart for finding the capacities of ball bearings of the radio-thrust type. The principles underlying the construction of the bearing are discussed briefly and its history is outlined.

THE idea of making an annular ball bearing in which the balls have contact with their raceways at an angle suitable to take a definite combination of thrust with radial load came to the writer in 1908 or 1909. With this basic idea in mind the writer proceeded to figure what contact angles would be required to give to such bearings various thrust capacities. He figured what angle of contact would give to such a bearing a thrust capacity one-fourth the radial capacity, what angle would give 50 per cent. thrust capacity, what angle 75 per cent. thrust capacity, and so on up to double and treble the radial capacity. Bearings of these various kinds were constructed and numerous tests made. Formulas were developed for the securing of the desired angles of contact and methods devised for the production of bearings of this type. A very extensive

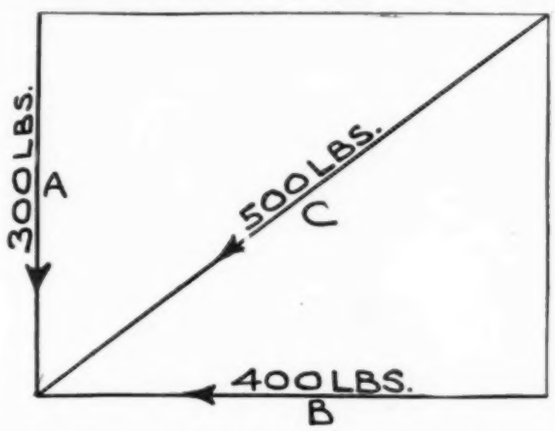


FIG. 1. PARALLELOGRAM OF FORCES

business has been built up on this type of bearing, which the writer christened the "radio-thrust bearing."

The radio-thrust bearing when first put upon the market some 10 years ago met with very general disapproval and even ridicule. The early pioneers in the development of the modern ball bearing had come to the conclusion that the proper way to take care of cases where there were loads of both a radial and an axial character was to use two types of bearings, a radial bearing to carry the radial load and a thrust bearing to carry the axial load. It was early found that the annular bearing as then developed was not at all suitable to take axial loads of any magnitude. Accordingly the dictum was soon laid down, and that with a good deal of emphasis and insistence, that where there were thrust loads of any considerable amount thrust bearings must be used. The experience of users of ball bearings amply justified this rule. With universal usage the practice solidified into a rule so rigid that no one thought of disregarding it.

When therefore the proposal was made to take a radial load and a large thrust load on one and the same bearing it was met with almost universal condemnation. It was directly counter to a rule based on universal experience and was accordingly rejected as rank heterodoxy. Some objected that we were undertaking the palpable absurdity of trying to make the balls roll two ways at once. So for some time the radio-thrust bearing got very scant consideration.

All this is now past and well-nigh forgotten history. It is not the first time that a rule firmly established by general practice has been incontinently swept aside by some innovation at first regarded as absurd. The first steamship that crossed the Atlantic carried a little book just off the press in which an English scientist proved by incontrovertible mathematics that a ship could not be built large enough to carry coal enough to generate power enough to drive the ship across the Atlantic. Doubtless his British complacency was unruffled by this circumstance. The bearing which the recognized authorities rejected as a palpable absurdity has become one of the most conspicuous successes in the bearing industry. Its sales have mounted up into the millions. It has begun to be somewhat generally suspected that the fundamental principles which the German doctrinaires laid down as the laws to which all ball-bearing practice must conform are after all not as the laws of the Medes and Persians. It might be something less than *lese majesty* to suggest that these principles were possibly incomplete.

In that highly specialized branch of mechanical engineering which has been developed along with the development of the ball-bearing industry there are two quite distinct sub-branches. There is a branch which investigates and analyzes the nature and characteristics of the loads that are to be borne on the bearings, and there is the constructive branch which designs and applies bearings appropriate to carry these loads most efficiently. When we come to analyze a mechanism to ascertain its bearing requirements we find loads of various magnitudes to be carried at various speeds. We find loads which are exerted in a direction perpendicular or at right angles to the rotating shaft, which we call radial loads. We find loads exerted in line or longitudinal with the shaft, which we call axial or more commonly thrust loads. And we find loads combining both radial and thrust elements. For example the loads coming from a spur gear are radial loads. The loads from a screw and from marine and aërial propellers are thrust loads. The loads from bevel gearing, from the various forms of helical or spiral gearing, from worm gearing, are a combination of both radial and thrust loads. The main spindles of most machine tools, such as lathes and milling machines, must carry both radial and thrust loads.

The bearing engineer who would make trustworthy mountings for taking care of such cases must make a correct analysis of the loads, must determine just what are the radial loads and just what are the thrust loads. When the ball-bearing engineer has made a correct analysis of the bearing loads of the mechanism under consideration and knows just what loads he has to take care of the very practical problem presents itself, How shall he most efficiently carry these loads? To clarify

the discussion let us take a very simple case. Let us suppose that the engineer has at a certain place a radial load of 300 lb. and a thrust load of 400 lb. Now there are two ways of taking care of this case. The old way is to provide a radial bearing to take the 300-lb. radial load and a thrust bearing to take the 400-lb. axial load. This, according to European authorities, whose word a few years ago was regarded as law and

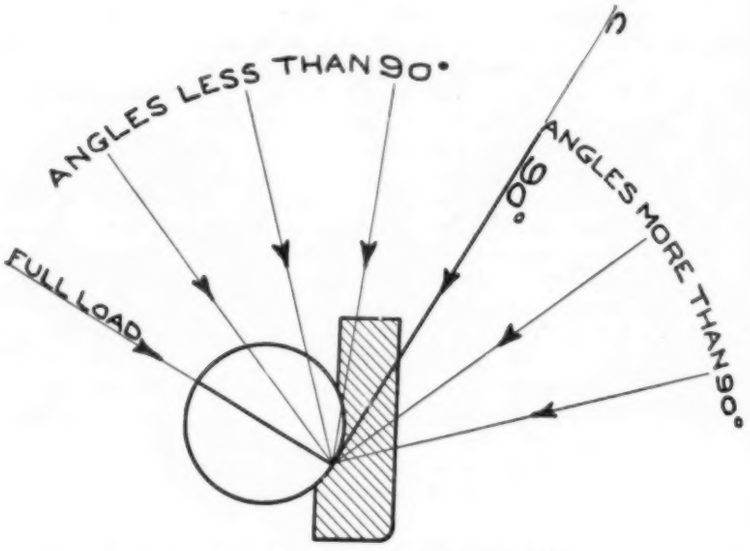


FIG. 2. DIRECTIONS OF LOAD UPON ONE BALL

not to be questioned, was the only proper way to take care of this case with ball bearings. The new way, the radio-thrust way, is to take the 300-lb. radial and the 400-lb. thrust load on one bearing.

Now there are one or two very significant differences to be observed in the actual load conditions as they exist in these two mountings. In the one case we are carrying 300 lb. on one bearing and 400 lb. on another. We are carrying on the two bearings a total load of 700 lb. In the other case we have a load of 300 lb. exerted radially and a load of 400 lb. exerted axially, or in a direction 90 deg. from the direction of the 300-lb. load. What is the total load in this case? It is not the sum of 300 and 400 lb. It is the resultant of 300 lb. and 400 lb. exerted at right angles. The actual load on this single radio-thrust bearing is only 500 pounds.

Everyone familiar with the most elementary principles of mechanics understands how the combination of two forces exerted in different directions is a simple and single force acting in one direction. This simple mechanical principle is usually shown graphically by the use of the parallelogram of forces (Fig. 1). The amount and direction of the two forces are represented by the vertical and horizontal sides of the parallelogram. The resultant force is shown, both in amount and direction, by the diagonal. Every lad in high school knows that the square on the diagonal is equal to the sum of the squares on the two sides. There is manifestly this very radical advantage in the single radio-thrust method of carrying combined radial and thrust loads; it effects a very material saving in the amount of the load that is actually borne on the bearings. With the use of a radial bearing and a thrust bearing, the bearings are actually loaded with the sum of the two loads, the full radial load, no less, carried on one bearing, and the full thrust load, no less, carried on the thrust bearing. With the loads combined on the one bearing the total load carried is not the sum but the resultant, the square root of the sum of the squares of the loads exerted at right angles to each other. ($C = \sqrt{A^2 + B^2}$.) In all cases the actual load borne is the resultant as shown by the parallelogram of forces.

Furthermore, there is not only this obvious large saving in bearing load effected by the radio-thrust method; there is great saving in the cost of bearings and their mounting. With the old method we must use two bearings and we must provide mountings and housings for them. By the new method we carry a materially reduced load on only one bearing requiring but the single mounting. The arguments from considerations of simplicity, efficiency and economy are all for the radio-thrust method.

Having now reduced these two loads, the 300-lb. radial, or vertical, and the 400-lb. thrust, or horzontal, to a single load of 500 lb. exerted in the diagonal or oblique direction shown by the graphic diagram of the parallelogram of forces, it remains to provide a suitable bearing to take this diagonal load.

Putting the case in this way we get a direct indication for a bearing of the radio-thrust type, a bearing in which the load line of the ball is inclined into the general direction of the line of force through which the actual load is received. In a limited or modified way the above phrase might be taken as a definition of the radio-thrust bearing. It needs, however, but little further consideration to develop the fact that a proper formula for the proper bearing to carry a diagonal load of a certain angular direction is not exactly one in which the load line of the ball, or the

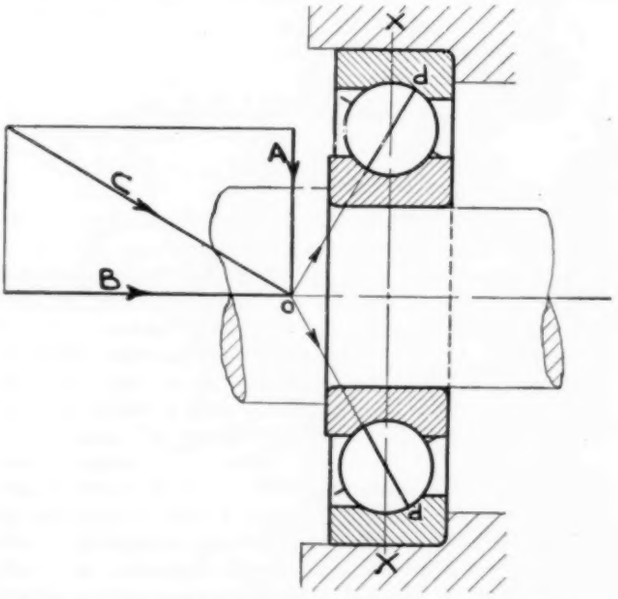


FIG. 3. RADIO-THRUST BEARING WITH LINES OF ACTION OF FORCES

Explanation: Radial load, a load exerted perpendicular to the shaft, as line A; thrust load, a load exerted longitudinally of the shaft, as line B; diagonal or resultant load line, actual direction in which combined load is exerted on bearing, as line C; load line of ball, a line diametrically through ball through the two spots of contact at right angles to the axis of rotation of ball as line *od*; angle of contact, angle between load line of ball and central plane $x - x$, of bearing.

line through the contact points of the ball, is coincident with the direction of the line of force through which the actual load is exerted. This would be the case if the load bore on only one ball. But when we consider that the load bears on a number of balls, and that the load line on each of these several balls extends in a different direction, the problem becomes somewhat complicated.

When the bearing is subject to a straight thrust load the load bears on all the balls, on each ball equally. When the bearing is subjected to a straight radial load the load bears, theoretically, on one-half the balls, on each ball in proportion to the cosine of the angle between the load line of the ball and the line of direction through which the load comes onto the bearing. To express this differently, a pure thrust load is borne equally around the whole circumference of the raceway. A pure radial load is borne on just 180 deg. of the raceway. (In this discussion we ignore complications due to compression or distortion of steel, bearing slack or lack of fit and similar irregularities.) As the direction of load varies from the vertical, or pure radial, to the longitudinal, or pure thrust, the amount of the raceway in load contact varies from the half to the whole. As the load inclines from the vertical or radial the amount of raceway under load increases from the 180 deg. As soon as the angle between the direction of load and the load line of the ball becomes less than 90 deg. the ball begins to take load. And this ball takes load in proportion to the cosine of such angle. The cosine of 90 deg. is 0. The cosines of angles less 90 deg. are positive quantities increasing as the angles become less until we get the cosine of the angle of 0 deg. which is 1, which means simply that when the ball comes under direct load it gets full load (Fig. 2).

Fig. 2 shows the manner in which the balls take loads coming from different directions. It represents the top ball in the bearing shown in Fig. 3. When the load comes upon the ball at an angle with the load line of the ball greater than 90 deg. the load tends to force the ball away from its contact with the raceway at *d* and of course the ball gets no load. This is the case when the direction of load varies from radial over to the line *C*, which is shown at an angle of 90 deg. from the load line of the ball. When the direction of the load passes the 90 deg. line *C* and the angle becomes less than 90 deg. the load begins to force the ball against the raceway, the pressure being in proportion to the cosine of the angle. As the direction of load swings around further the load becomes greater and greater as the angle becomes less and less until we get full load when the direction of load becomes coincident with the load line of the ball and the angle becomes 0. The cosine of 90 deg. is 0, the cosine of 0 deg. is 1.

The load lines of the balls converge at a common point 0. (Fig. 3.)

Now it is quite plain that when we have a bearing of the radio-thrust type, one in which the balls contact with the raceways at an angle rather than vertically

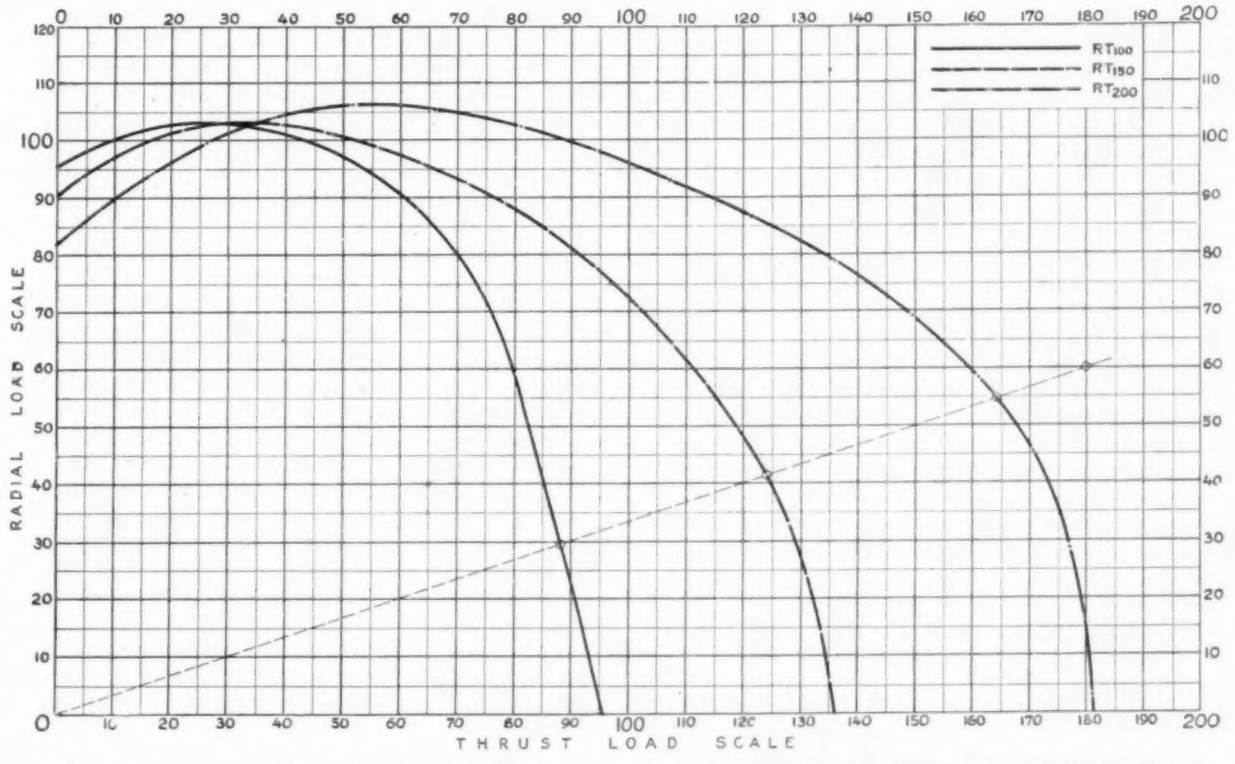


FIG. 4. CHART SHOWING STATIC CAPACITIES OF RADIO-THRUST BEARINGS UNDER DIFFERENT LOADS

These curves show the capacities of the radio-thrust bearings, in percentages of the regular rated loads, to carry various combinations of radial and thrust loads. On this chart the radial and the thrust components of a combination load may be laid off and the resultant load determined both in its direction and amount, the same as by the parallelogram of forces. By measuring the length of this resultant line to where it crosses a curve we get the capacity of the bearing to carry that particular kind of load. For example, we have laid out on this chart a load made up of 600 lb. radial and 1800 lb. thrust. A line drawn to a point 60 points up, or radial, and 180 points out on the thrust scale measures about 190 points diagonally from the 0 point, or corner, showing the resultant actual load to be about 1900 lb. Where this line crosses the curves shows that for a load the resultant of this particular combination of radial and thrust loads a 100 per cent. bearing has a capacity of about 93 per cent. of its rated load, that a 150 per cent. bearing has a capacity of about 131 per cent. of its rated load, and that a 200 per cent. bearing has a capacity of about 173 per cent. of the rated load. If we are to use a 100 per cent. bearing we must select one whose rated capacity times 0.93 equals 1900 lb. If we use a 150 per cent. bearing we must select one whose rated capacity times 1.31 equals 1900. If we use a 200 per cent. bearing we must take one whose rated capacity times 1.73 equals 1900. These load determinations must be modified by proper factors based on considerations of speed, shocks, and the conditions of service. Put more into the shape of a formula, we would say: The rated load of the proper bearing should equal the indicated resultant load times a speed factor times a service factor divided by the percentage indicated on the load curve.

or radially, and subject this bearing to a diagonal load, that is, a load inclined from the vertical or radial, we have a complication of angles between this line of load direction and the load lines of the several balls. If we can determine what these angles are it is a simple matter to determine the capacity of the bearing to carry such a particular load. Having determined the angles between the line of the load and the load lines of the balls under load the static capacity of the bearing as regards this particular load is in proportion to the sum of the cosines of these angles.

Load Capacity of Various Types of Radio-Thrust Bearings Graphically Illustrated

In order to establish the actual load capacity of the various types of radio-thrust bearings to carry loads of various degrees of inclination, we have by this method computed the load capacity of these several bearings to carry loads from all directions. From these computations we have plotted curves which show graphically just what are the load characteristics of the different types of radio-thrust bearings. We have embodied these curves into a chart, Fig. 4, which enables one to ascertain almost at a glance just what is the capacity of any one of the radio-thrust bearings to carry any kind of load that may be imposed upon it. This system of load computation for the radio-thrust bearing disposes of all uncertainty as to what is the capacity of these bearings to carry known loads. It puts the radio-thrust bearing on the same plain footing as regards load capacity as the plain radial and the plain thrust bearings.

The curves on this chart show just what is the capacity of either type of radio-thrust bearing to carry a load from any diagonal direction. The chart is used as follows: If it is desired to find the capacity of a bearing to take a load made up of, say, 650 lb. radial and 400 lb. thrust we read up 65 on the vertical or radial scale and project this point over to 40 on the horizontal or thrust scale. A line drawn from the 0 point to this 65-radial 40-thrust intersection will give the amount and direction of the resultant load, about 765 lb. This line extended to cross the load curves shows that a 100 per cent. radio-thrust bearing will carry about 109 per cent. for a load in this direction, that the 150 per cent. will carry about 115 per cent. for such a load and the 200 per cent. will carry about 124 per cent. Any point on a curve shows the per cent. capacity of the bearing for a load in the direction of a line drawn through such point to the zero point of the chart.

Consideration of Speed and Friction Cannot Be Ignored

It should be stated in this connection that these load characteristics as shown by this scheme are for static loads. They do not take into consideration the effect of speed and friction upon the available working capacities of bearings. Considerations of speed and friction cannot be ignored, except at slow speeds. That is another matter, and of great importance, which we will not undertake to discuss at this time. It will perhaps be treated in another article. This discussion and these curves pertain to actual bearing pressures and to the actual load-bearing characteristics of the several types of radio-thrust bearings as based on definite limits of contact pressure between balls and raceways. A radio-thrust bearing of either type having a load whose direction and amount is represented by a line drawn from a point in its load curve to the 0 point on the chart is so loaded that the maximum load to which a ball is subjected is $d^2 \times 2\pi$, d being the diameter of the ball in sixteenths of an inch.

The Metric System in Export Trade*

By Frederick A. Halsey

Commissioner, American Institute of Weights and Measures

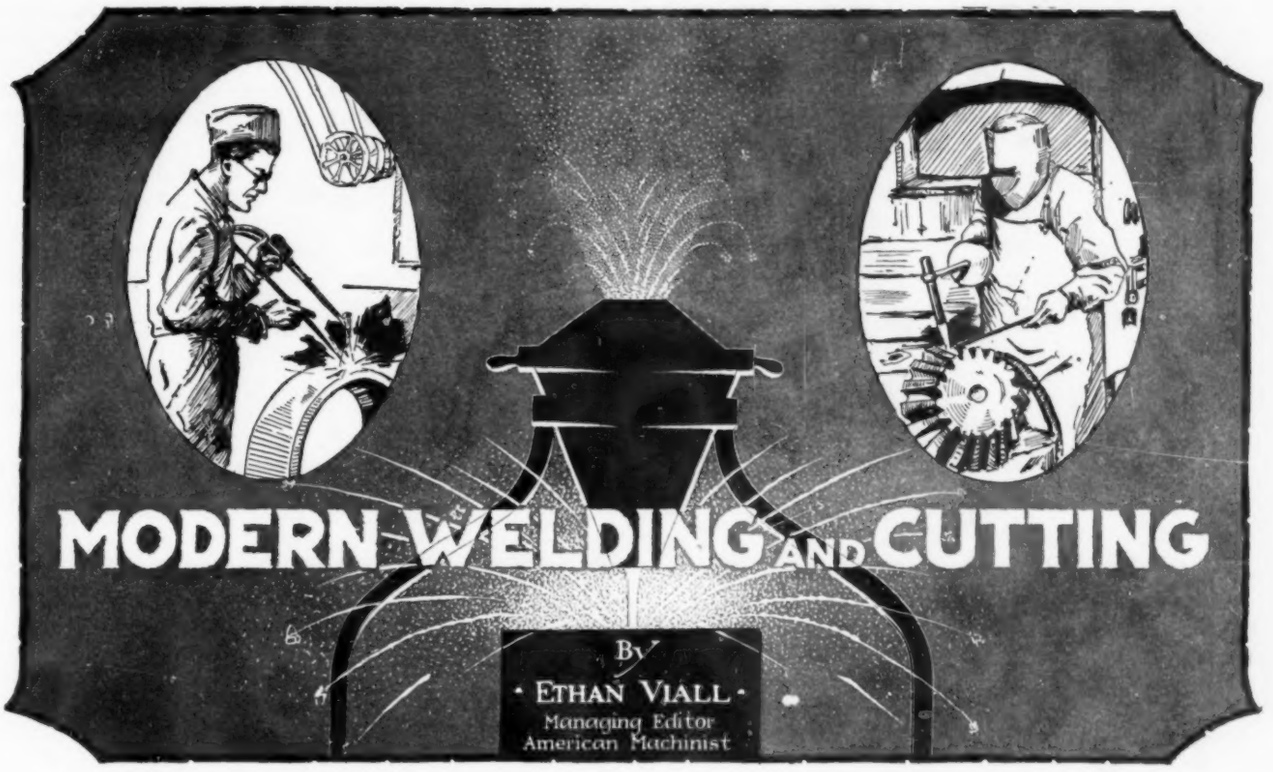
The problem of the adoption of the metric system does not lie in the introduction of the metric units but in getting rid of the English units. If the English units are to continue in use, we will have a double standard with infinite complexity and confusion due to their conjoint use.

Since the outbreak of the world war, we have heard repeated insistence that we must adopt the metric system if we are to succeed in the cultivation of foreign markets. We are told that when selling to others, "we must deal with them in language they understand." We are told that "our weights and measures are meaningless to them," that "they have forgotten their old units," that, in short, "in export trade, we have no choice—we must come to the metric system."

Like other metric arguments, there is a specious plausibility about these statements, but instead of relying upon generalities, let us consider the sale of specific commodities. In normal times, we import large numbers of high-class French clocks, and similarly we export tens of thousands of cheap clocks to all parts of the world. It would be absurd for an American purchaser to object to a French clock because it was made to the metric system, and equally absurd to suppose that foreign purchasers would object to our clocks because they are made to the English system. To come still nearer home, American watches are made to both the English and the metric systems, but not one watch owner in a thousand knows or cares to which system his watch was made. It is not conceivable that a foreign purchaser should fail to select an American typewriter because its parts are made to the English system. Still another illustration is found in the automobile trade. In former days when the French led in automobile construction, large numbers of French automobiles were sold in this country, but no one ever heard raised as an objection against them the fact that they were made to metric measure. At the present time, the situation is reversed. Our automobiles have taken possession of the markets of the world and the fact that they are made to English measures is nowhere raised against them.

It is precisely so with every other commodity that can be named. From shovels to watches, and from wheelbarrows to automobiles, the units of measure to which goods are made have nothing to do with their salability in any market. In normal times we import vast quantities of goods from metric countries which we buy without thought or question of the units of measurement to which they are made. Just as metric countries give no thought to the adoption of the English system in order to sell goods to us, so there is no reason why we should consider adopting the metric system in order to sell goods to them.

*Abstract of address delivered before the twenty-fourth annual convention of the National Association of Manufacturers at the Waldorf-Astoria Hotel, New York City.



XIV. Gas-Pressure Regulators and Working Assemblies*

The pressure regulators used on gas-torch apparatus are very important instruments and should be carefully handled. Details of some of the well-known makes of regulators are here given, together with directions for their assembly to the apparatus. Directions are also given for the lighting of a torch, and the various flame characteristics with different gas combinations are shown by drawings.

SINCE the gas pressure required in a welding or cutting torch is normally considerably less than that of a generator or storage cylinder, some form of pressure reducer or regulator must be used between a torch and the source of gas supply. The regulator used must not only reduce the pressures to working amounts, but must keep the gases supplied to the torch at as constant a pressure as possible regardless of the variation in the pressures at the sources of supply. This will be understood when it is shown that, for example, oxygen at 1800 and acetylene at 225 lb. pressure per sq.in., taken from cylinders must be mixed in a Davis-Bournonville positive-pressure torch at approximate pressures of 14 and 6 lb. respectively, when welding steel plate ½ in. thick. The pressure in the cylinders will constantly decrease as the gases are used, but in order to keep a correct neutral welding flame the gases must be supplied to the mixing chamber of the torch at the approximate pressures of 14 and 6 lb., and kept close enough to these figures for long periods of time to produce the desired flame without continual adjusting of the valves. The required working pressures are determined by the thickness of the metal being operated upon, the make of torch, and the size of tip being used, as tables already given indicate, but the principle remains the same in any case.

The gas-pressure regulators used on welding and cutting apparatus are practically all made on the same general principle and vary only in minor details of construction. An Oxweld oxygen regulator shown in Fig. 144 will serve to illustrate the construction in general. The principal parts of a regulator of this kind are the body proper, regulating or shut-off valve, diaphragm, pressure-adjusting spring and pressure-indicating gages. As a general rule all regulators have two pressure-indicating gages, one on the intake or high-pressure line, and one on the outlet, or low-pressure line. The gage, however, on the low-pressure acetylene line is sometimes omitted when using a low-pressure, or injector, torch on account of the low pressure at which the acetylene is used.

In the illustration given, a dust or protecting plug is shown screwed into the connecting nut on the intake tube. This is of course removed when attaching the regulator to the supply pipe or valve. The arrows indicate the flow of the gas when free to move from the intake to the outlet. Following these arrows it will be seen the gas enters the intake and flows into the vertical passage *A* where it goes upward to the high-pressure gage *B*, which indicates the pressure of the supply line. The gas also flows downward in the same passage until it reaches the monel-metal nozzle of the regulating valve at *C*. If the screw *D* is turned to the left far enough to prevent spring *E* from forcing the diaphragm *F* inward against the sliding sleeve, then spring *G* will keep the seat *H* solidly against the nozzle *C* and no gas will enter the body of the regulator beyond the passage *A*. However, if the screw *D* has

*For the author's forthcoimng book, "Welding and Cutting."
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been run inward far enough to put a tension on spring *E* the diaphragm *F* will be forced inward and the regulating valve will be held open. Gas will then flow into the diaphragm chamber *I* until the pressure of the gas against the diaphragm overcomes the pressure of spring *E*. This allows spring *G* to close the regulator

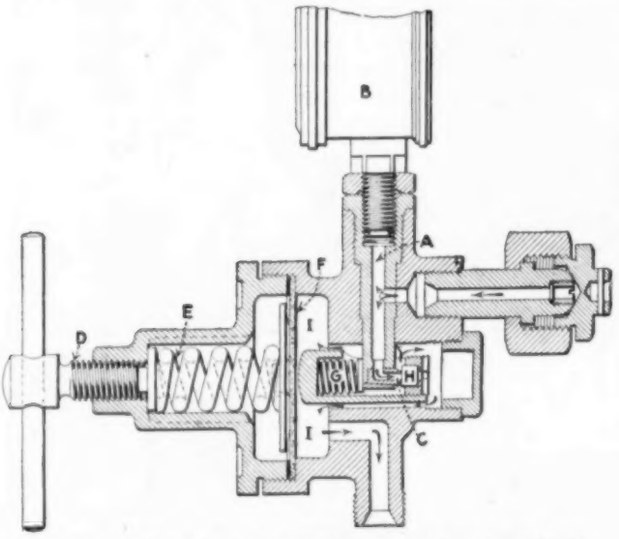


FIG. 144. DETAILS OF OXWELD OXYGEN-WELDING REGULATOR

valve and stop the flow of gas. The flow is not usually actually stopped when the torch is in use, since the flow of gas and the pressure of the spring *E* will be so balanced as to allow just enough gas to enter to keep the pressure practically constant in the outlet line. The farther the screw *D* is run in the more tension is put on the spring *E* and the diaphragm *F*, and consequently the higher will be the gas pressure in the outlet line to the torch. From this it will be seen that any desired pressure within the capacity of the

FIG. 145. OXYWELDED OXYGEN-WELDING REGULATOR

regulator can be obtained, and maintained, in the outlet to the torch by simply adjusting the screw *D*. The diaphragm used on a regulator of this kind may be made of reinforced sheet rubber, phosphor bronze or other composition metal that will not corrode or break easily.

The regulators used for other gases differ but little from those used for acetylene or oxygen, and often the same regulators may be used provided the pressures required are within the range of the regulator in question. An oxygen regulator for cutting work should be built heavier and deliver a larger amount of gas than one used for welding on account of the higher pressure required and greater gas consumption. In using acetylene from a pressure generator it is good practice to have an acetylene line regulator as well as one for each operator's torch line.

The Oxweld oxygen gages used when welding are made to register from 0 to 2700 lb. per sq.in. on the

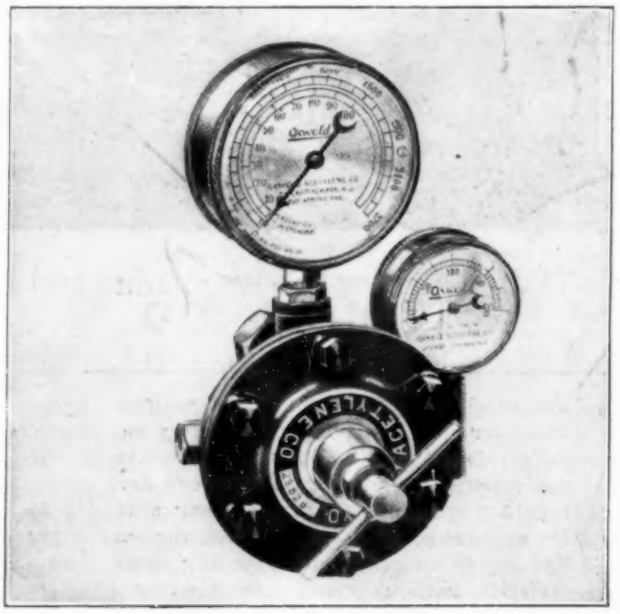


FIG. 146. OXWELD OXYGEN-CUTTING REGULATOR

high-pressure side and from 0 to 60 lb. per sq.in. on the low-pressure side, as shown in Fig. 145. It will be seen, by examination, that the outer scale on the high-pressure gage shows the pressure in pounds and the inner scale indicates the percentage of gas in the cylinder. That is, for example, if the gage hand points to 600 lb. there would be approximately 35 cu.ft. of oxygen left in the cylinder, providing a 100-cu.ft. cylinder was being used. If it was a 200-cu.ft. cylinder the amount left would be approximately 70 cu.ft. As has been pointed out elsewhere, these figures cannot be taken as showing the exact amount of gas in the cylinder except under certain conditions, but they are sufficiently accurate for all ordinary purposes.

For cutting purposes the Oxweld oxygen regulator shown in Fig. 146, is fitted with the same gage on the high-pressure side as for welding, but on the low-pressure side the gage registers up to 200 lb. per sq.in. Their acetylene regulator is only supplied with a 350-lb. gage on the high-pressure side, as shown in Fig. 147. This is because of the fact that the Oxweld torches use acetylene at about 1-lb. pressure at all times. However,

FIG. 147. OXWELD ACETYLENE REGULATOR

if required, two gages may be used as in all other makes.

A Davis-Bournonville oxygen regulator with gages is shown in Fig. 148. This indicates from 0 to 3000 lb. per sq.in. on the high-pressure side and up to 400 lb. on the low-pressure side. On the dial of the high-pressure gage are three rows of figures. The outer row shows the pressure per sq.in.; the middle row, the cubic feet of contents for both 100- and 200-ft. cylinders; the inner row indicates the cubic feet of contents for 250-cu.ft. cylinders at various pressures. Details of a regulator used for acetylene are shown in Fig. 149. This is practically the same in construction as the oxygen regulator. The numbers shown are list numbers of the parts, and are very convenient for ordering broken or damaged parts at any time. The regulator acetylene gages register up to 400 lb. on the high-pressure side and up to 300 lb. on the low-pressure side.

An oxygen regulator made by the General Welding and Equipment Co., attached to a cylinder is shown in Fig. 150. At the right and almost opposite from where the regulator is attached, is a projection which is a fusible blow-off plug required on all cylinders by the Interstate Commerce Commission, to provide for the escape of the gas in case the cylinder should be overheated and the pressure become so great as to be liable to cause an explosion. This illustration clearly shows the kind of valve that is used on an oxygen cylinder. It is completely covered with a metal cap screwed onto the threads shown at the top of the cylinder. The cap protects the valve and prevents it being broken off or damaged when the cylinder is handled or shipped. In using gas cylinders under working conditions it is advisable to have them placed on a portable truck made for the purpose, or else fastened in some way so that they cannot be tipped over. This will often prevent needless damage to the apparatus and sometimes avoid serious accidents. It should always be kept in mind that gases under from 225- to 1800-lb. pressure per square inch are not to be trifled with.

Oxygen cylinders of different concerns do not have a uniform color, but are usually painted gray and green, red, yellow, or dark-green. Acetylene cylinders are generally painted black and have a plate on them giving the quantity of gas the tank contains. Practice also varies as to the color of hose used to connect to the torches. Common colors are black hose for acetylene and red hose for oxygen. In making all hose or valve connections, they must be carefully blown out to remove dust or any foreign substance. This is especially important on new hose which is almost sure to contain considerable bloom left from the vulcanizing. In addition to their specific color, acetylene cylinder valves are often threaded left hand, as a safeguard against making the wrong connections.

In making oxygen connections it must be remembered that under no circumstances should oil or grease be used on the oxygen regulator or cylinder valve. This is highly important as oxygen under pressure coming in contact with oil or grease causes spontaneous combustion which might easily result in a serious accident. If a lubricant of any kind is needed a little glycerine may be used.

Regulator Adapters

No make of regulator is so made as to be regularly interchangeable with all makes of gas cylinders, since the sizes and threads used on different makes of cylinder connections vary considerably. For this reason adapters must be used in many cases. Some of these are shown in Fig. 151. Care should therefore be taken to make sure that the regulator will fit the cylinder connections properly, or that the right adapter is used. If a regulator connection or an adapter does not start readily, it should not be forced as it is probably the wrong diameter or the thread may be of the opposite kind—that is right- or left-hand. Also be sure that an adapter with a round or conical seat is not used on a flat seat, nor a round seat on a conical one or one not made for it. Adapters are made of soft brass and

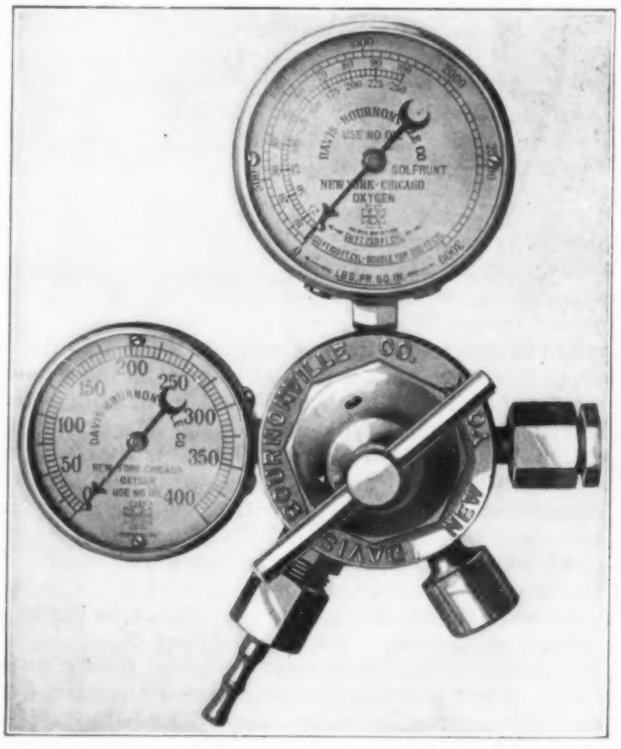


FIG. 148. DAVIS-BOURNONVILLE OXYGEN REGULATOR

careless handling will cause a leaky joint. In ordering adapters the make of regulator used should be specifically stated, and also the make of cylinder on which it is to be used, as well as whether it is for oxygen, acetylene, hydrogen or other gas.

In order to make perfectly clear to the reader how to connect up a welding apparatus for the first time, an Imperial welding outfit is shown in Fig. 152. First remove the protecting cap from the oxygen cylinder, and then open valve *A* very slightly. This is to blow out any dust and to insure the free working of the valve after the regulator is attached, which otherwise

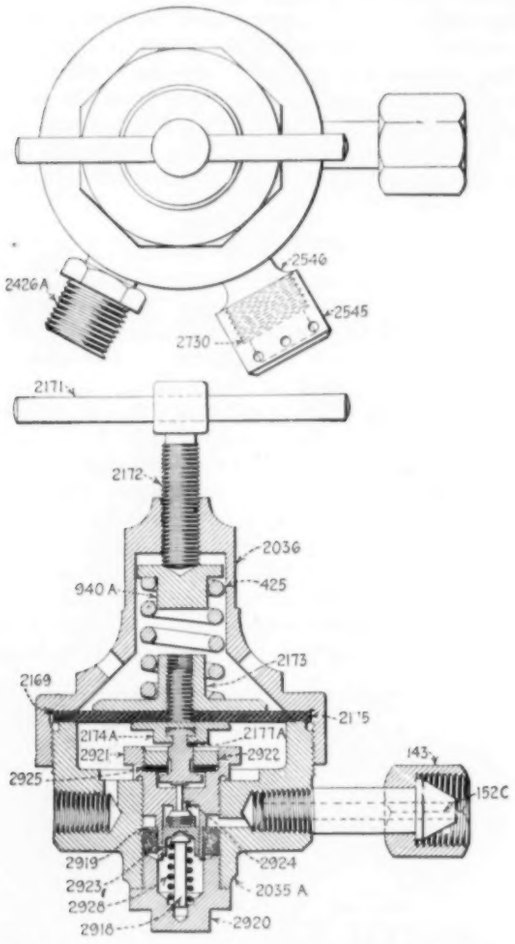


FIG. 149. DETAILS OF DAVIS-BOURNONVILLE ACETYLENE-PRESSURE REGULATOR

might be injured by the sudden rush of gas into it. In doing this, stand on the side opposite from the opening so that the gas will blow *away* from you. Always keep this in mind when blowing out the valve on *any* cylinder. Now take the regulator and turn the handle *B* to the left until it turns freely, so as to be clear of the diaphragm. Next make sure the connection at *C* is clean and free from dirt and fits properly or has the right adapter, then screw it up using judgment with the wrench so as not to break anything. With the valve at *D* closed, *slowly* open the valve *A as far as it will go*, using some force with the hand to insure that it is really backed up against the gland solidly. This is to aid in preventing the high-pressure oxygen from escaping around the valve stem. When the valve is fully opened, the gage *E* will indicate the cylinder pressure which on a new one will be close to 1800 lb.

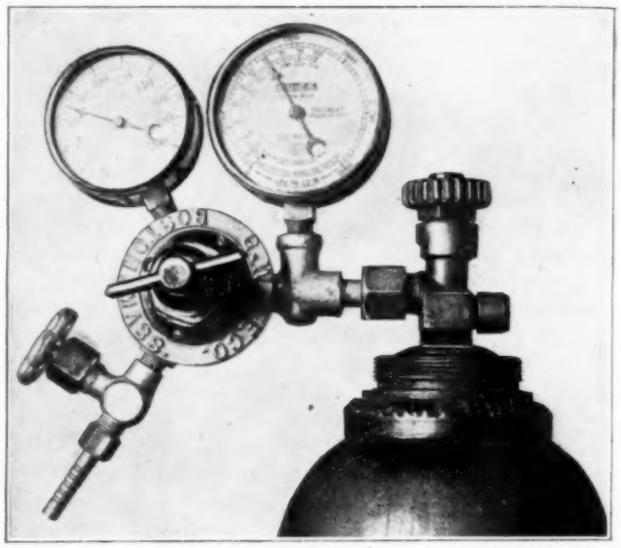


FIG. 150. REGULATOR ATTACHED TO A GAS-CYLINDER VALVE

Now put on the oxygen hose at *F* and then turn the handle *B* to the right until about 5 lb. are registered on gage *G*. Then open valve *D* so as to blow any dirt or bloom out of the hose. The valve *D* is then closed and the hose connected to the torch at *H*. The valve *I* on the torch may now be closed, the valve *D* opened, and the handle *B* screwed in until the gage *G* registers the proper pressure for the proposed welding job, as indicated in the pressure table for the make of torch being used. The various connections should then be carefully gone over with soapy water to test for leaks. Never use a flame on the oxygen or any other gas tank even though oxygen alone is not inflammable. Assuming that the proper tip has been placed in the torch for the thickness of metal to be welded, the torch valve *I* may now be opened fully and the handle screwed in until the gage *G* registers about 2 lb. over the pressure given in the table. This is to allow for the variation in cylinder pressure as the gas is used. The torch valve *I* is next closed, and it is also well to close the valve *D* as a safeguard before attaching the acetylene hose.

The acetylene regulator and tank are now connected up in exactly the same way, except that the acetylene tank valve *J*, must be *only opened one full turn.* (On one make of cylinder the directions say two turns, so the operator should read the directions on the tank carefully.) The hose is connected at *K* and blown out to

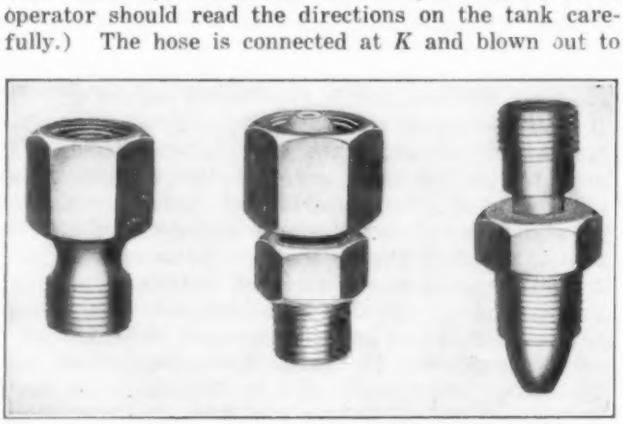


FIG. 151. REGULATOR AND CYLINDER-CONNECTION ADAPTERS

remove any dirt, care being taken that no flame is near. It is then connected to the torch at *L*, and tests are made for leaks as before with the valve *M* open and the torch valve *N* closed. The torch valve *N* is next slightly opened and the issuing gas lighted. The valve is then fully opened, and if the gage *O* shows any appreciable drop, the handle *P* should be turned until the gage registers about 2 lb. above the amount shown by the table. The resulting flame from the burning acetylene will be long, white, smoky, and of comparatively low temperature. The torch valve *N* may then be manipulated until the pressure blows the flame from $\frac{1}{16}$ to $\frac{1}{4}$ in. away from the tip, the distance depending on the size of the tip being used. This can only be judged properly by experience. The oxygen may now be turned on slowly. The flame will gradually reduce in size, the outer end or envelope becoming less luminous and the part near the torch tip, known as the cone, assuming a clear outline without any ragged edges. When this is obtained, turn off the oxygen slowly until a shadowy point shows from the cone. Then with extreme care turn on the oxygen again until this shadowy point just disappears. This is the so-called neutral flame, and is neither oxidizing nor carbonizing.

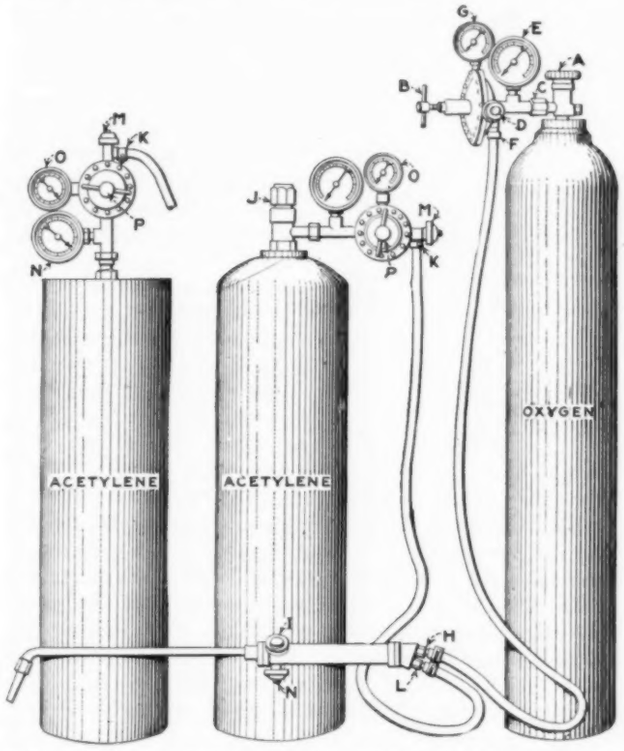


FIG. 152. IMPERIAL WELDING OUTFIT CONNECTED TO TANKS

From time to time, while at work, the operator should test the flame as just outlined, as a slight excess of oxygen pressure will not readily show in the flame and can only be detected by this method. It will be found in practice, as a rule after the pressures have been set on the gages, that all regulation necessary for the smaller sizes of tips may be made with the torch valves, but that on the larger sizes it is often advisable to readjust at the regulators. It will be well to repeat here, for the benefit of the beginner, that all indicated table pressures are only approximate and good only for the make of torch mentioned in connection with them.

The chart shown in Fig. 153 will serve to illustrate the looks of the oxy-acetylene flame as far as it is possible to do on paper: *A* shows acetylene turned on with sufficient pressure, so that it blows away from the tip. This space depends upon the size of tip being used. *B* shows oxygen partly turned on, united with the acetylene. The flame has begun to assume two different shapes and two different colors. The center flame is white and is shaped somewhat like a rosebud. Not enough oxygen has yet been given the acetylene and the flame is called carbonizing. Such a flame will leave the metal brittle and hard. *C* is the neutral welding flame. The rosebud cone of the upper figure has become blunt, with no ragged edges and of a beautiful blue-white color. *D* is an oxidizing flame—ruinous to welding. This is obtained by turning on too much oxygen and the cone has become shorter, of a darker, dirtier blue, and is more pointed. This view is exaggerated. The utmost care is necessary to guard against this flame. Even a slight excess of oxygen is detrimental, as it will "burn" the metal.

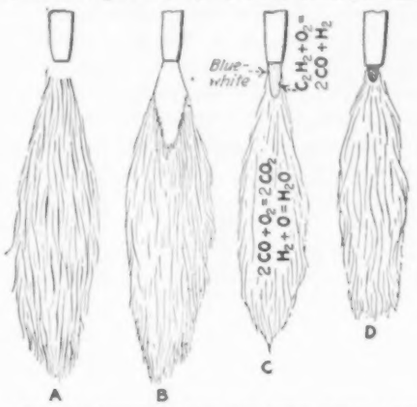


FIG. 153. CHARACTERISTICS OF THE OXY-ACETYLENE WELDING FLAME

To stop work temporarily, first close the oxygen valve in the torch and then the acetylene valve. To stop work permanently, first close the torch valves in the order just given, then screw back both regulator handles until they are free of the diaphragms. Then shut off the tank valves tightly.

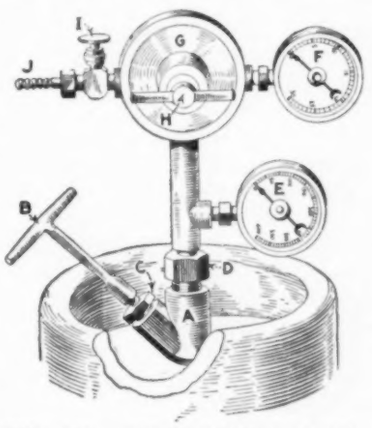


FIG. 154. PREST-O-LITE ACETYLENE-REGULATOR ASSEMBLY

In case of a flashback, always close the oxygen valve instantly, then the acetylene valve, after which the torch head may be cooled in a bucket of water.

It should always be kept in mind *never to turn on the gas at the cylinder with the regulating screw tight, as this puts spring tension on the diaphragm* and allows the gas from the cylinder to enter the body of the regulator very suddenly (because the plunger of the valve is away from the seat) and as

the sudden pressure strikes the diaphragm, the plunger is thrown violently against the seat, often causing the seat to become cracked or broken.

With the motor of an automobile racing, you wouldn't throw the gears in mesh for high speed direct from neutral and attempt to start away from the curb—not if you wanted to keep your automobile very long—yet turning on the oxygen with the spring tension on the regulator has about the same effect on the regulator.

Bear in mind that the regulator is a steadying device—that the diaphragm is the balance between the high pressure of the cylinder gas and the spring tension

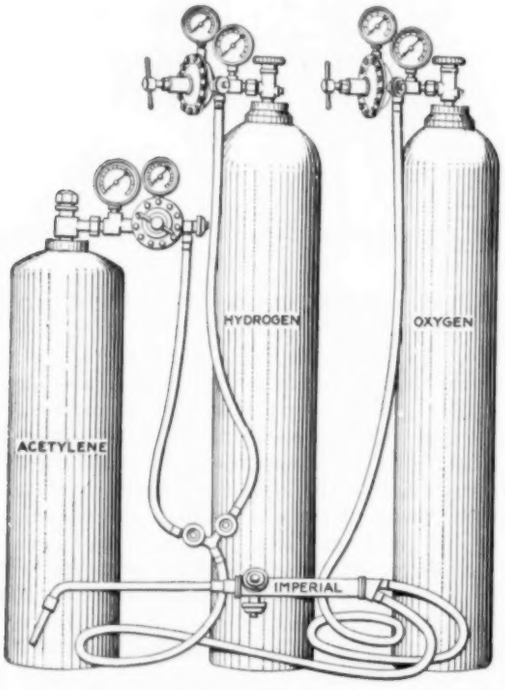


FIG. 155. IMPERIAL THREE-WAY-GAS OUTFIT

and that at all times the movement of this diaphragm should be slow—never violent.

The low-pressure gage is a positive index of regulator trouble. If you are operating, say at 15 lb., and after shutting off the valve on the torch, the hand on the dial keeps moving to 25 or 30 or 40 lb. without stopping, it means that the seat is damaged—that the high pressure of the cylinder is leaking past the plunger of the valve and the regulator should be immediately sent back to the factory for repairs. Only by violating some of the rules previously given would you be likely to damage this seat; but once damaged, it should be immediately repaired.

It will be noticed that two acetylene tanks are shown in Fig. 152. These represent the two types in common use. The one in the middle is the type furnished by both the Air Reduction Sales Co. and the Commercial Acetylene Co., while the tank at the left is furnished by the Prest-O-Lite Co. In the first named the regulator stands out at right angles, and in the other it stands up as shown. The valve in the Prest-O-Lite cylinder differs considerably from the others as will be seen in Fig. 154. In this illustration the valve is shown at *A*, the valve wrench at *B*, the packing nut of the valve at *C*, and the union nut by which the regulator is attached, at *D*. *E* is the high-pressure gage, *F* the low-pressure gage, *G* the regulator, *H* the pressure-adjusting handle, *I* the outlet valve and *J* the hose nipple. The directions given by the Oxweld company for the lighting of their low-pressure or injector torches, differ slightly from the foregoing, so they will be quoted here, starting from where the gases have been turned into the high-pressure sides of the regulators, which is the same as already outlined:

First, connect the oxygen hose from the oxygen regulator to the hose connection on the torch marked oxygen. Likewise connect the acetylene hose to the torch valve marked acetylene. Then select the proper welding head or tip that is to be used according to the chart or table furnished, and screw it carefully into the torch. Turn on the oxygen by means of the handscrew of the oxygen regulator until the pressure on the small gage is as given on the chart. Be sure that when this is done the oxygen valve on the torch is open. Then close this valve. Open the acetylene valve on the torch. Then turn the handscrew on the acetylene regulator to the right until acetylene is passing through the torch. Then close the acetylene valve on the torch.

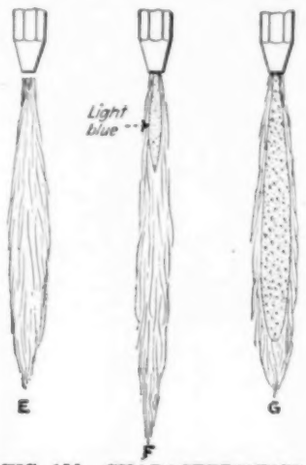


FIG. 156. CHARACTERISTICS OF THE OXY-HYDROGEN FLAME

The apparatus is now ready for use, and the gases are further regulated when necessary by adjusting the valves on the torch itself. Open the acetylene valve entirely. Open the oxygen valve slightly. Then light the gases. After lighting the gases, open the oxygen valve wide; adjust the flame by turning the acetylene valve to the right until a neutral flame is produced.

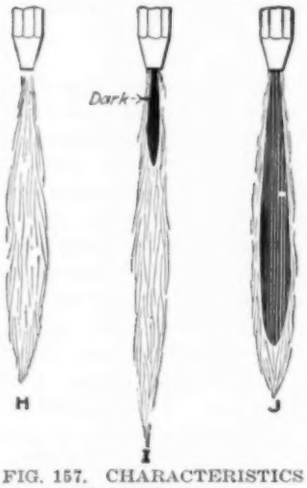


FIG. 157. CHARACTERISTICS OF THE HYDROGEN-COMPRESSED-AIR FLAME

When the job is finished and you want to shut off the torch for a short time, release or turn the handscrew on both oxygen and acetylene regulators to the left until the flame on the torch goes out. Then close the torch valves. When work is completed for the day and the apparatus is to be put away, first close the acetylene valve, then the oxygen valve of the torch. Then turn off the valves on *both* cylinders. Then open the valves on the torches until all the gas in the regulators and hose passes out of the torch into the air. Then turn the handscrew of both regulators to the left until loose. Then disconnect the oxygen and acetylene regulators from the cylinders. Each regulator has a dust plug which is to be put on its cylinder connection during all the time the regulators are not connected to the cylinders.

Place the regulators and torches with wrenches, goggles, heads, and tips in their proper place so that they will be safe and protected from dust, dirt, and rough handling. Roll up the hose and put it in the case or tool box where it belongs.

According to the Prest-O-Lite company, the chemistry of the oxy-acetylene flame is as follows: Acetylene (C_2H_2) is composed of carbon (C) and hydrogen (H). On combustion, the carbon combines with oxygen to form carbon dioxide (CO_2) and the hydrogen combines with oxygen to form water vapor (H_2O). This takes place in the following manner:

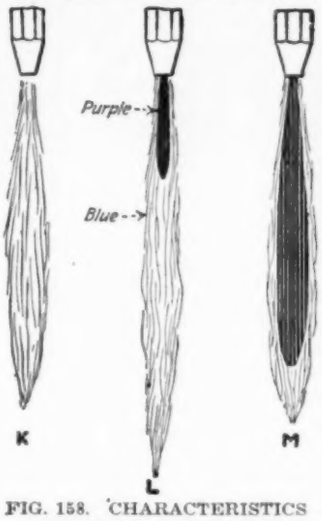


FIG. 158. CHARACTERISTICS OF THE OXYGEN ILLUMINATING GAS FLAME

When the gases issue from the torch into the welding flame, the acetylene immediately dissociates; in other words, it *splits up* into carbon and hydrogen which in combination with oxygen form respectively carbon dioxide and water vapor. In consequence of the high flame temperature (6300 deg. F.) the water vapor formed by this primary combustion, is immediately dissociated into hydrogen and oxygen. The oxygen assists in the burning of the carbon while the hydrogen (which can only combine with oxygen at a temperature below 4000 deg. F.) passes away from the high-temperature zone and combines with the oxygen of the atmosphere at the outer blue part of the flame, where the temperature is sufficiently low to permit it. The result of this is that the inner or welding cone of the flame is protected by a shield of free hydrogen which prevents loss of heat and also tends to protect the weld from oxidation. The temperature of the oxy-acetylene flame is approximately 6300 deg. F., at the hottest part of the flame, which is the tip of the inner white cone. The effect of this tremendous heat at the point of treatment is to bring the metal very rapidly to a molten state so that it flows together and mixes thoroughly with the proper quantity of metal added by the operator.

The molten mass thus formed does not merely cement two pieces of metal together—it *fuses* them into one uniform mass.

Characteristics of Other Gas Flames

The way an Imperial three-way outfit is connected up is shown in Fig. 155. The procedure is along the same lines as outlined for the oxy-acetylene work. This combination of oxygen, acetylene and hydrogen gives a more visible flame and a sharper cone than oxy-hydrogen alone does. Only a small percentage of acetylene is necessary to give the sharper cone but the flame retains the clearness, beauty and good qualities of the oxy-hydrogen flame. The percentage of acetylene may be varied according to the thickness and character of the metal being welded, so that the degree of heat and amount of carbon can thereby be regulated to meet different conditions. The approximate pressures to be used for the three gases for average work, will be found in a previously given table. The combination will produce a heat of about 5000 deg. F.

The oxy-hydrogen flame will produce a much softer weld than oxy-acetylene if properly used, but its lower heat and the fact that the cone is not concentrated in a sharp needle point, which allows the heat to radiate more, are drawbacks when heavy welding is attempted. The low visibility of the oxy-hydrogen flame also makes it difficult to regulate properly, and an operator requires considerable experience before he can become proficient in its use. As has been already mentioned, however, its long flame makes it very desirable to use for the preheating flame in a cutting torch, especially on heavy, thick work. In welding with the oxy-hydrogen flame, the torch has to be held farther away from the work than with the oxy-acetylene torch on account of the longer and less concentrated flame. When a black spot appears in the weld it shows that the torch is being held too close.

The characteristics of the oxy-hydrogen flame are shown in Fig. 156. In this illustration, which is as clear as a flame can be represented on paper, the different flames are outlined as follows: *E* shows the hydrogen turned on with sufficient pressure so that it blows away from the end of the tip. The distance will vary from about $\frac{1}{16}$ to $\frac{1}{4}$ in. according to the size of tip and pressures used. *F* shows the oxygen turned on. A narrow, light-blue streak appears in the center of the hydrogen mantle. This is the desired neutral flame. *G* is an oxidizing flame that will burn the metal. The oxygen valve should be gradually closed until the excess of oxygen disappears.

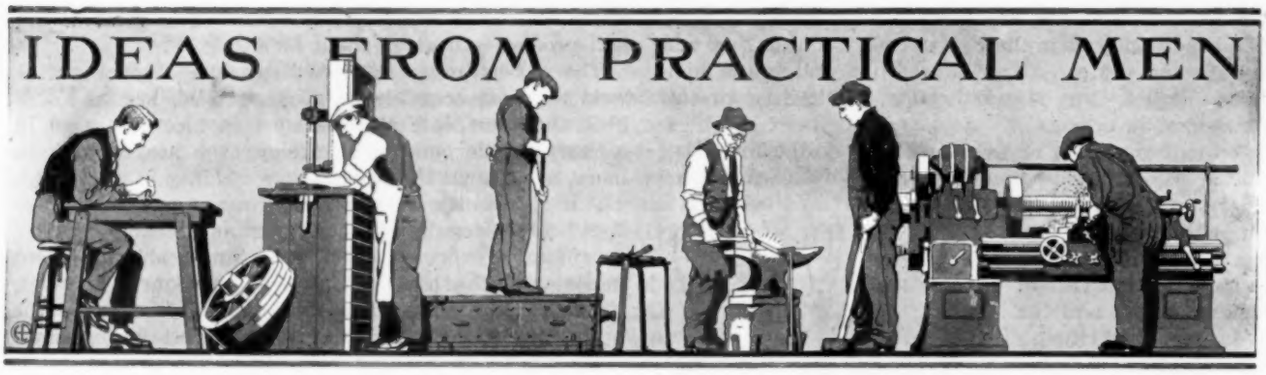
Where hydrogen and compressed air are used as done in preheating work, light welding, or lead burning, the flame closely resembles that of the oxy-hydrogen flame. The appearance of the hydrogen-air flame is indicated in Fig. 157. *H* shows the hydrogen turned on with pressure enough to blow the flame away from the tip, the distance being about the same as already given. *I* shows the compressed air turned on and a dark streak of mixed air and hydrogen appears in the center. This is the neutral flame. *J* is the oxidizing flame.

In general the air pressure used for this flame is close to that where oxygen is used.

The flame produced by mixing oxygen and coal gas, or natural gas, is suitable only for lead burning, preheating, very light steel welding, light cast-iron welding, or the welding of light brass or aluminum. The characteristics are shown in Fig. 158. *K* shows the gas turned on full force enough to slightly blow the yellow flame away from the tip. *L* is the neutral flame produced by turning on the oxygen. The cone is narrow and about $\frac{1}{2}$ in. long, of a beautiful purple color in a pure-blue outer mantle. *M* shows too much oxygen. The cone has turned a reddish color. The oxygen must be decreased until the sharp purple-colored cone appears. In using oxygen and illuminating gas, a water seal should be used on the gas line to assist in purifying the gas and to prevent the entrance of any flame, or oxygen which might form an explosive mixture.

Where acetylene and compressed air are used, as sometimes done for certain preheating or welding jobs, the flame characteristics closely resemble the oxy-acetylene flame.

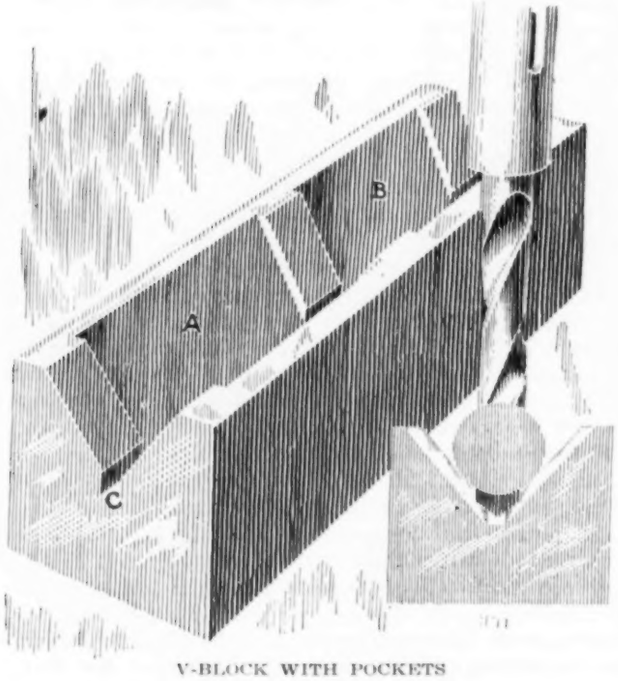
In order to obtain the best results, special tips should be used in the torch for the different gas combinations described. These can usually be promptly supplied by the makers of any of the torches on the market.



An Improvement in V-Blocks

By S. W. Palmer

The type of V-block shown in the illustration has been found to be very useful and may be of some interest to other readers. The block differs from the ordinary type in that it is machined from a casting having



V-BLOCK WITH POCKETS

V-shaped depressions as shown at *A* and *B*. These depressions permit the use of a comparatively large drill, since they provide clearance for the drill in passing through the work so that the surface of the V is not marred. The ordinary block is milled from a solid piece and has a slot as shown at *C*. This slot provides clearance for small drills, but for general work, blocks constructed as shown have been found more satisfactory.

Tools for Drilling Deep Holes

By H. H. Esbenshade

It is sometimes necessary to drill unusually deep holes with a considerable degree of accuracy when, owing to the nature of the work, the only practicable tool is the upright drilling machine.

The cut shows some drills which we made for drilling holes 42 in. deep, the material being nickel steel and the machine used, a 4-ft. radial. These drills were forged from high-speed steel, being first made like a flat drill, and then twisted to the shape shown in the cut. They were forged somewhat over the nominal diameter and were finished accurately to size by grinding.

One great difficulty in the drilling of deep holes is the clogging of chips in the hole. To remove these chips we made a magnet which is also shown in the cut. It consists of a piece of cold-drilled steel $\frac{7}{8}$ in. in diameter wrapped for a distance of 5 in. near one end

TOOLS FOR DRILLING DEEP HOLES

with No. 22 cotton-covered magnet wire properly taped and varnished to protect the winding from injury.

The current was supplied from the lighting circuit with a lamp in series with the magnet to control the flow. A double-pole knife switch was used to cut the magnet out of circuit when its services were not required.

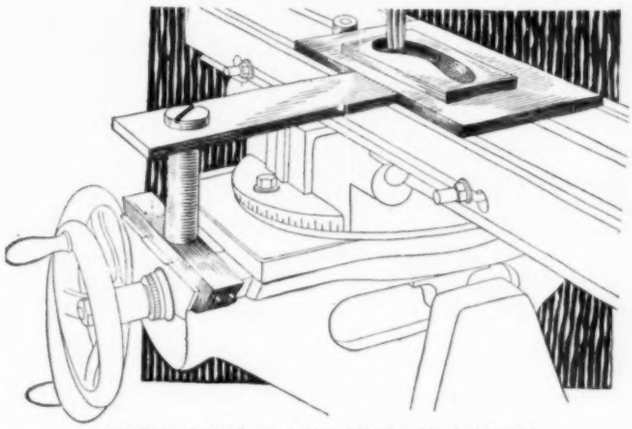
Cutting Large Radius Curves on a Milling Machine

By John Chip

On page 32 of the *American Machinist*, there was described a method of cutting the links for a marine engine on the slotting machine. Having work of like nature, I provided the bed of a milling machine with a tail or radius bar at right angles, and a proper center point of rotation on the knee block of a well-bedded shaping machine. Nor did I forget the heavy brace between the two machines.

Then I removed the crossfeed screw of the milling machine and found that the bed would travel in a perfect large radius circle. My gratification, however, died suddenly when I put on the vertical milling attachment and tried to cut a true curve.

For cutting links the idea might be all right, but where an absolutely true circle is required it is not to be recommended. The mill cut in too deep toward the end, due probably to a slight play which became very noticeable when the tail bar reached a decided angle. Another difficulty arose when trying to put back the cross screw on the milling machine. It was necessary to remove the entire knee and connections, as after



SIMPLE DEVICE FOR MILLING RADIUS

many trials, I was unable to replace the screw otherwise.

My conviction is that the described method is *not* a good one and I suggest simply laying a flat, well-greased plate on the milling-machine bed, connect it to a radius bar and let the bed of the milling machine move the plate along by pushing it with a roller vertically fastened to the bed. A curve of extreme accuracy can thus be cut at a small fraction of the cost and trouble of the previously described method. The sketch indicates how I would do it.

Making Difficult Duplicate Gages

BY B. A. MUNSON

On page 162 of the *American Machinist*, E. A. Dixie gives his solution of the problem of making duplicate gages, the principal dimension of which was to be taken

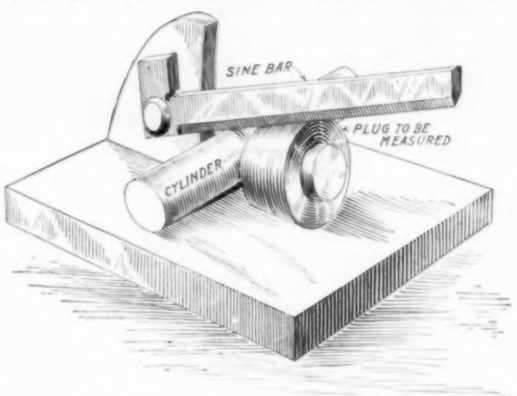


FIG. 1. MEASURING THE MASTER PLUG WITH A SINE BAR

at the intersection of a cone and a plane surface. The difficulty of securing this measurement was greatly augmented by the fact that the metal at this point of intersection was cut away to provide clearance for a grinding wheel.

Mr. Dixie's solution was to make a master gage by grinding the outside of a cylindrical piece to the exact diameter of the required circle, and at the same setting to grind it internally to the angle of the cone until one end of the piece was brought to a sharp edge. A ring, accurately ground to fit over the cylindrical piece, was then laid on a surface plate, the piece entered in the hole and pushed down until the sharp edge came in contact with the plate; the ring having been warmed somewhat to permit this.

This gage had in my estimation two serious defects:

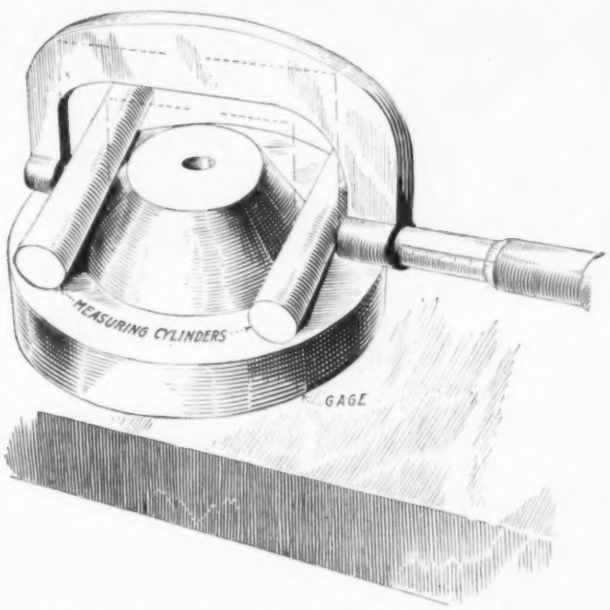


FIG. 2. MEASURING THE GAGE WITH WIRES

(1) The uncertainty of any measurement dependent upon an absolutely sharp edge, especially when the limit of error is to the fourth decimal place; and (2) it depended upon what Mr. Dixie called a "very light shrink fit" (between the ring and the cylindrical piece) to maintain its accuracy.

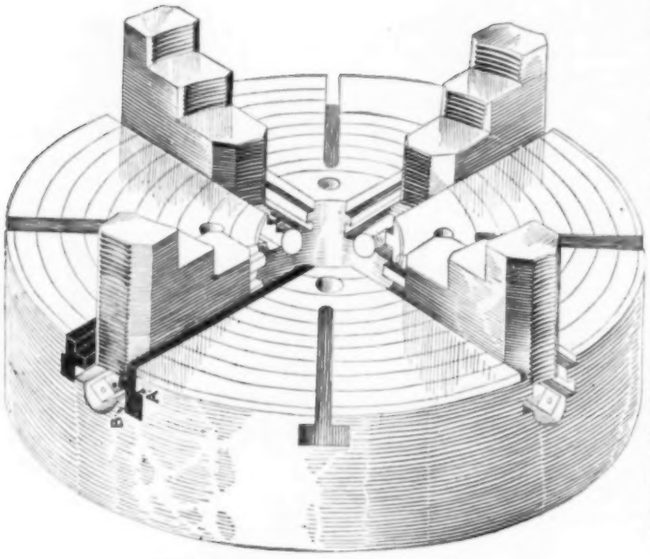
A better way to make the master gage would have been to make a taper plug, gaging it with a cylinder and sine bar as shown in Fig. 1, and then setting the plug into a base. Another way would be to make the first piece, gaging it as shown in Fig. 2, and then make the master gage to it, using prussian blue in the manner described by Mr. Dixie.

Repairing a Broken Chuck

BY FRANK ERVIN

The snagging of a cutoff tool under a heavy cut was the cause of a jaw being broken out of a 22-in. four-jawed independent chuck, the cast iron breaking out from the face of the chuck, allowing the jaw to fall out. As it was impossible to obtain a new chuck at the time this happened, we decided to repair the break, the work being accomplished as shown by the sketch.

Two pieces of steel were planed to the shape indicated and the chuck planed out so that they would drive in. The strain to which these pieces are subjected when the chuck is in use is all borne by the shoulders *A* and *B* so that no additional means of securing the inserts was necessary beyond driving them to place.



REPAIRING A BROKEN CHUCK

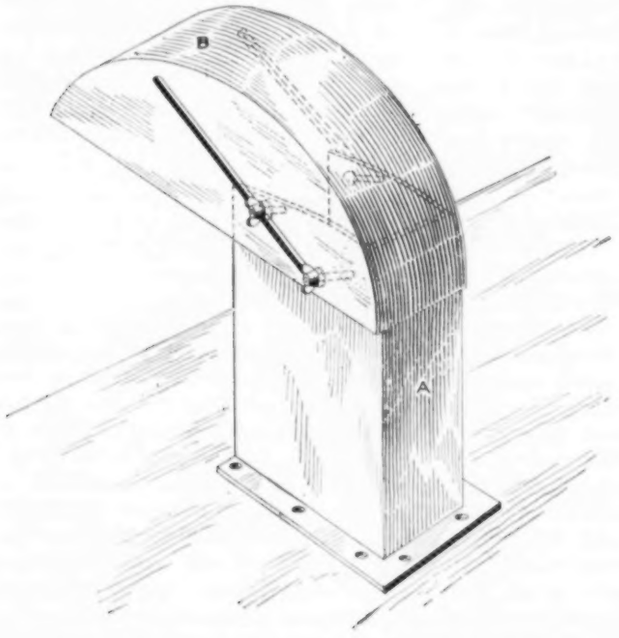
The work was done on a shaping machine, and though it involved some close measurements, it was accomplished successfully, the jaw fitting into the new channel as nicely as in the old one. The repaired chuck has been in service for nearly a year upon the heaviest class of work of which it is capable and shows no sign of distress.

A Guard For Grinding Wheels

By D. Molony

A simple and easily made guard for grinding wheels is shown in the sketch, which clearly indicates the manner of construction. The material may be galvanized sheet iron of suitable gage.

The part *A* is stationary, being attached to the bench by screws through the flange, and covers the back of the wheel. The adjustable cover *B* is attached to this stationary part by means of small bolts fitted with wing nuts extending through slots cut in both parts.



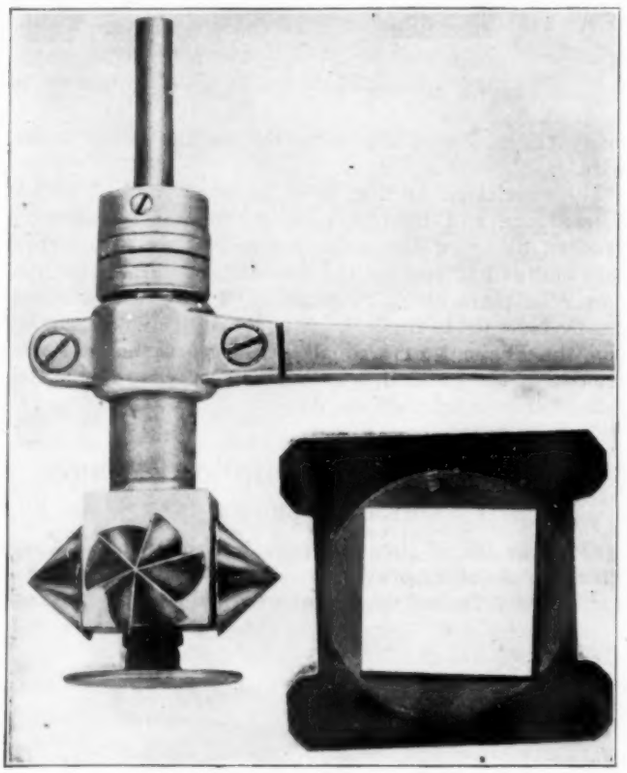
SHEET-METAL GUARD FOR GRINDING WHEEL

The cover has a long slot on each side extending forward at an angle while a shorter slot at an opposing angle is cut in each side of part *A*, thus part *B* may be adjusted forward and back, up and down, or tilted to any desired angle to cover wheels of any diameter within its range.

A Boring Tool for Polygonal Holes

By K. H. Condit

C. H. Schmidgall of Peoria, Ill., has designed and built the illustrated tool for boring holes of other than circular outline in wood, marble or metal. The model shown cuts a square hole in iron as illustrated and has four cutters. It is first necessary to drill or bore a round hole of the same diameter as the pilot or guide shown below the cutters. The tool can then be mounted in a drilling machine and held by means of the handle,



A BORING TOOL FOR SQUARE HOLES

part of which appears in the cut. The cutters are operated by bevel gears of substantial construction. Particular care has been taken to provide ample bearing surfaces for the gear spindles and the inventor attributes much of the success of the device to this feature.

This cutter will work equally well in marble, passing through a 1¼-in. piece in about four minutes. The model used for cutting wood varies from the other in that it has a vertical pilot cutter in place of the plain pilot, and a modified form of cutter to suit the different working conditions. This obviates the necessity of making a round hole and permits the job to be done in one operation. The arrangement and shape of the cutters may be modified to produce various shapes of holes.

Convention of Drop Forge Associations

IN ACCORDANCE with their annual custom, the American Drop Forge Association and the Drop Forge Supply Association met in joint convention at Pittsburgh, Penn., June 12, 13 and 14, 1919. A lengthy program of papers and discussions had been prepared for the meeting which emphasized, in its way, the growing importance which this industry is yearly attaining in the manufacturing field.

The officers of the Drop Forge Association were all reëlected to serve for another year and consist of the following: President, E. J. Frost, Frost Gear and Forge Co., Jackson, Mich.; vice president, J. F. Connelly, Champion Machine and Forging Co., Cleveland, Ohio; secretary, A. W. Peterson, American Drop Forger, Pittsburgh, Penn.; treasurer, E. B. Horne, Packard Motor Car Co., Detroit, Mich.

The business sessions which were conducted by the Drop Forge Supply Association were not of lengthy duration, and after the disposal of a small amount of routine business the general officers were all reëlected to serve for another year, and will be as follows: President, H. N. Taylor, N. and G. Taylor Co., Philadelphia, Penn.; vice president, Charles Harmon, Jr., National Machinery Co., Tiffin, Ohio; secretary-treasurer, A. L. Wurster, Sizer Forge Co., Philadelphia, Penn. The two new members added to the executive committee are: I. N. Schlendorf, Central Steel Co., Massillon, Ohio, and Alexander MacInnes, Hammond Steel Co., Syracuse, N. Y.

In his opening address the president, E. J. Frost, of the Frost Gear and Forge Co., included the following remarks:

The past year has been one of grave responsibilities and has called for unusually strenuous endeavor on the part of some, if not all our members.

Disposal of Government work on hand, both finished and partly completed, together with the absorption, re-sale, or turning back to the Government of raw stocks, was no easy matter, and incapable of expeditious handling; and, added to this the discomfiture of waiting for months to have adjustments made and claims allowed, followed by other periods of grim waiting for cash to replenish badly depleted working capital, put new furrows in the brows of some of you, that even a fishing trip to the incomparable trout streams of Michigan could not remove.

To my mind, the subject of standardization presents, perhaps, the greatest opportunity for elimination of waste and stopping of undesirable conditions, sometimes deliberately imposed by our customers.

Standardized proposal and contract forms could be adopted by the association, so drawn as to allow latitude to cover the varied requirements of the entire membership.

I have no thought of controlling prices, for I doubt if this would be practical even if legal, but undoubtedly some unfair practices can be stopped by concerted action and definitions made and rules laid down that will eliminate much friction, waste and worry.

Such items as the following could well be subjects for consideration and possible adoption: Terms of payment; responsibility for delivery; methods of settling disputes over mechanical defects; forger's responsibility when using steel furnished by the customer; a proper charge for handling steel furnished by the customer; questions arising from customer's impaired credit; consequential damages; patent liability, and who pays the transportation on rejected goods, etc.

Mechanical standardization will be of untold benefit to our membership if it does nothing but define limits of accuracy on various types of work and outlines acceptable methods of inspection.

It should be borne in mind that the establishing of standard limits is not a function of the inspector, the work of the inspection committee being to define acceptable ways of determining whether agreed upon or defined shapes, drafts or limits have been adhered to.

In order not to make the work too burdensome to the few, the labor involved could be divided by having subcommittees covering separate subjects.

Another subject worthy of our attention, and perhaps warranting a committee, is industrial relationship, looking toward the cutting down of labor turnover and the systematic making of new help to meet the demands of an ever-widening industry.

In view of the tremendous increase in equipment to meet the war needs, it undoubtedly would be to our advantage to be studying new avenues of outlet for our augmented capacity, rather than ruthless cutting of prices, to keep our men and hammers going. New industries are continually being started, and a campaign of education might reasonably be expected to bring worth while returns in profits from hitherto untouched sources.

Return of the Soldiers

Most of us have service flags hanging in our offices or shops, some of them bearing stars of gold, in token of those who not only gave up good positions and comfortable homes to receive small pay and undergo the hardships and privations that are the inevitable concomitant of war, but laid down their lives, that national selfishness and sordid greed and lust and ruthless destruction of property, and inhuman, bestial conduct toward womankind should not only be stopped now, but be put forever in a leash that cannot be broken.

There is an incessant stream of the boys in khaki who are coming home, many broken in body and health and possibly in spirit, most of them passing in sight of that emblametic hand on Bedloe's Island, reaching out to them the torch that symbolizes liberty and enlightenment and a "square deal," and we surely will be remiss as American citizens and employers of workers, if we do not go far beyond the limits ordinarily set by business, and not only give them employment, but be patient with them while they slowly bridge the gulf that lies between what war has made them, and the redemption, that, through us and others like us, all over the country, may come to them.

Col. H. P. Bope, Pittsburgh, made one of the leading addresses upon the "Present Status of the Iron and Steel Situation, With Special Reference to the Forging Industry." He sounded a note of optimism for the metal industries and for the nation's business as a whole, but warned his audience not to expect much in the line of reductions in the cost of raw materials, which will be held near their present levels largely by the present high cost of production.

"The Low-Pressure Exhaust Steam Turbine," with its peculiar adaptabilities to the production of considerable quantities of power from the waste gases of the furnaces and exhaust steam from steam hammers, was discussed by an interesting technical paper presented by H. V. Schoepflin of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn.

W. C. Peterson of the Packard Motor Car Co., Detroit, Mich., presented a paper entitled "Heat-Treating Problems That Originate in the Forge Shop," which read as follows:

There can be no doubt that all of us have, during the last three or four years, experienced wonderful developments in the art of making good forgings.

I am sure that all of us will further agree that we are surprised, generally speaking, at the results of good forging, plus good heat-treating. The war program just ended brought more grief to these two branches of the making

of munitions than all the other branches put together. We have all had our own personal experiences, perhaps, and it is the purpose of this paper to summarize and picture as a whole those irregularities which were found in the finished product, and were traced to bad forgings. By "bad," we do not wish to mean arbitrarily "bad," but bad in a comparative sense when weighing the ultimate answer.

First, we can classify our forgings into two distinct kinds, namely: Those which are subsequently to be machined and carbonized, and those which are subjected to heat-treatment after forging.

Of the first class there particularly is one phase to consider and that is that the carburizing or cementation of steel is daily receiving more and more attention as a result of increased demands made upon the art. The very nature of the process calls for a very scrutinizing control of the raw material from its making in the steel mill until it is ready to machine after forging. This control calls for particular attention to the presence of surface slag, which is the worst enemy of the carburizing process, and which accentuates its presence by tremendous growth under heat in carburizing material. Small areas of slag and oxide become very much larger during the cementation process, and produce much irregularity in hardness of the finished product, which, of course, is undesirable.

Careful investigation into the trouble experienced on carburized parts show us the following:

That this oxide appears to be buried in some classes of drawn and rolled bars, as well as forgings, extending from the surface toward the center of the part, and can be likened to a sort of pit, with considerable depth at times.

These pit marks of oxide, as I will call them, seem to increase considerably in size upon carburizing and have been found to be the nucleus, so to speak, for scale formations on the part when subsequently heated and quenched for hardening.

Under these scale formations we find soft spots rendering the cemented part unfit for use in abrasive or wearing service.

Observation points out that these oxide pockets on the surface of bars and forgings are not always due to faulty steel, and do not penetrate very far into the part. By taking a very thin layer off the part so affected, it will be found that the machined surface is entirely free from scale or soft spots, while the untouched portion of the part will be the opposite. Investigating further, and applying the investigation particularly to forgings, we come to the conclusion that dirty forgings are the cause thereof. Scale formed by the contact of the air with the hot forging, if not constantly blown off, will be actually buried in the surface of the forging to a depth which does not permit its removal by machining under ordinary conditions.

Effect of Buried Scale

In these days when it is required to forge parts which shall be within $\frac{1}{64}$ in. of machining size, you readily realize that to bury scale in the forgings is not the best practice, and should be avoided by making clean forgings. It may be opportune to state that it was found this oxide deposit in forgings was more pronounced in some steels than others and is accounted for perhaps by the fact that some steels scale more than others.

Of the second class of forgings much can be said, but I intend rather to touch only on the most vitally important points. I believe many, if not all of you, will agree that the ultimate cost of a part is of prime importance today. This not necessarily means cost in dollars and cents, but quality as well. There is one phase in the manufacture of parts from forgings which plays a very great part in the ultimate cost, and this is the distortion of parts in heat-treating and hardening. When such parts do distort, it is always necessary to apply remedies such as straightening in the one instance, and further machining or fitting in the other. The former operation interferes considerably with the quality of the forging, while the latter usually draws the attention of the management from the standpoint of cost in dollars and cents.

To straighten a forging after heat-treatment means a decrease in the clastic limit, and just how much it is quite difficult to determine. Therefore, the metallurgist who has arranged heat-treatments to meet the demands in physical properties which the engineer has imposed, is laboring under a false conception as to results obtained. Also in straightening, strains are sometimes concentrated in certain parts of a forging which are very often the sole cause for serious failures. Straightening, therefore, should be avoided if possible, for the several good reasons pointed out above.

But what has this to do with forging, you ask?

An explanation will be attempted, by citing actual occurrences and a close observation thereof. After several years' study as to the cause and subsequent cure for the distortion of steel parts during heat-treatment, I believed I had sufficient knowledge on the subject to make general applications. But to my dismay at the time, my results varied and it became necessary to seek the disturber. The test in question related to the hardening of a certain type of gear.

Effects of Forging Methods

Batches of a hundred at a time were put through this heat-treating process until finally we were able to send them from the hardening room with little or no distortion. This continued for some time until finally a batch came through which were distorted in the same percentage as we had been getting good gears before. Careful checking of the hardening process, such as temperatures, rate of treating, method of cooling, etc., revealed nothing, and we thereupon visited the forge shop. Here records showed that all gears made prior to the incident of the distorted batch came from one particular hammer operated always by the same workman. He had apparently taken no particular pains to standardize his time of heating or hammer blows, yet, nevertheless, his gears gave uniform results as regards percentage of distorted gears. The bad batch of gears came from another operator working at a different hammer and who likewise did not have, to all appearances, any set rule for doing this or that. Yet, the change in operator was evidenced at the hardening room, and disturbed both the quality and quantity of gears produced considerably. And, in passing, let me be understood in saying that the quality of work done at the hammer by the second workman was equally as good as that of the first, and that by altering our heat-treating process somewhat, we were able to harden his batch of gears with the same accuracy as the previous batch.

Here, then, we have a picture, which in my opinion is worthy of consideration. Without any pretext on the part of the hammerman to standardize the making of his forgings, he unconsciously rendered them to the heat-treating plant in a fairly uniform condition because of the very continuity and repetition of the operations in forging. Another operator could not obviously produce forgings with the same characteristics, and as a result we would have as many different kinds of conditions metallurgically in gears as there were different operators, provided no attempt had been made to standardize the forging process from its several angles.

Such standardization, however, I predict must come, and is already here in some instances, because drop-forging steel parts today is vastly different than at the time this society was started. The drop-forger should sit in seance with the heat-treater and hardener, not to listen so much to the story of bad forgings, but to familiarize himself with the problems which confront the hardening room, which can be quickly remedied by clearly understanding the causes thereof.

It was my good fortune to witness during the war program the heat-treating of a certain engine part which demanded very close limitations as regards physical properties, and consequently, therefore, needed the closest attention in heat-treating. These forgings came from three different sources, and were made from steel coming from one mill. In fact, two of these sources made the same forgings from the same mill heat of steel. When delivered to the heat-treating department, it was found that a certain

percentage of each lot of forgings needed a second drawback in order that they conform to the required specification, and for your information I cite these figures: Lot No. 1, 58 per cent. redrawn; lot No. 2, 20 per cent. redrawn, and lot No. 3, 2 per cent. redrawn.

In no lot was a burnt forging found, although in lot No. 1 several slightly overheated forgings were present. This is but another instance of where different results in heat-treating were evidenced, due to the difference in the methods of forging.

In all well-regulated heat-treating plants, parts are checked and inspected for hardness by means of either the scleroscope or Brinnell machine. The scleroscope is preferred in most instances on account of the comparative ease in operation, and can be quite safely relied upon if proper standardization and comparison has been made in each kind of steel. It is in the use of the scleroscope, then, that we discover at least one serious irregularity which is traced directly to the forge plant, and it is that of decarburization. Parts decarburized show a lower reading on the scleroscope and cannot be correctly inspected, which in turn means rejection or failure.

Effects of Oxidizing Flame

Decarburization of forgings is caused, no doubt, by the application of a very "hard" oxidizing flame to the forging furnace, which when continued for any length of time changes the structure of the surface of the steel by diminishing the carbon content. These de-carburized areas will not respond to a treatment intended for the original steel, and cause irregularities which are uncertain and dangerous. The precaution, then, in observing the correct kind of flame in treating forgings adds to our list for the making of good forgings, and the heat-treating plant, I am sure, will susbtantiate my assertions in this respect.

In closing, we would summarize the several points brought out. Standardization of operations in forging, the application of the correct kind of flame, and clean forgings make for an ultimately better product.

In many production systems the bonus plan is applied only to the producers, and all of the auxiliary workers of the plant are outside of its benefits and not interested in the best developments to attain efficiency. However, in the forging plant of the Timken-Detroit Axle Co., Detroit, Mich., the bonus system has been arranged so that all are directly benefited, from the top man to the most lowly worker. L. K. Wilson of this company presented the following paper entitled "A Bonus Plan as Applied to an Entire Forge Plant," explaining the methods by which this object has been attained:

A well-known psychologist has made the statement of a fact that "when wages are based on commission, piece-work, or a bonus or premium system, the stimulus to action is constantly present. Every stroke of the hammer, every sale made, every figure added increases the wages. The wage thus continuously beckons the worker to greater accomplishment." Another eminent efficiency engineer states that "in order to find and take the best, easiest and quickest ways to the desirable things of life, we must use the thirteen principles of efficiency, which are records, plans, schedules, dispatching, standard conditions, standard operations, standard instructions, ideals, common sense, discipline, competent counsel, fair deal and rewards."

Thus we could go on and quote passages from many volumes which have been written in recent years setting forth the advantages of certain methods of increasing the efficiency of men, departments, shops and nations. Employers of labor have therefore realized the necessity for and advantage to be gained by installing some of the methods so presented, whereby their workers will receive something in addition to their wages for the conscientious effort.

No doubt we all feel that the terms, "scientific management," "industrial efficiency," "individual effort," have been greatly overworked, that they have been magnified, enlarged and misconstrued until they are beyond the comprehension of the average human being on whom they are ultimately tried out, so that the real honest good that might be accomplished is lost on account of the complication. I do not believe that there is any one plan which would be absolutely adaptable to more than one plant. Take our own business for an example—I do not believe it possible to find any two forge shops where conditions are identical even though we have many things in common, but I do believe, however, that the forging industry offers a splendid opportunity for the accomplishment of many gratifying results, through the medium of some plan; not from the standpoint that they are any more inefficient than any other industries and it would be an easy matter to show results, but from the standpoint of the nature of the work being usually regular, simple as to number of operations, but more especially the type of men employed in forge shops are such that if you once gain their confidence and they see that your plan is good and that they will get a square deal, there is no question but that their coöperation and interest will be secured and held and results accomplished satisfactorily.

Nearly two years ago a bonus plan was adopted at the Timken-Detroit Axle's forge plant whereby every employee connected with the organization, regardless of position, would share in the bonus earnings in proportion to their wages. There is no question but that this plan has produced satisfactory results, and we therefore consider it good enough to pass on to others whose conditions are somewhat similar to ours and who may be willing to take up a proposition of this kind after someone else has tried it out and overcome the difficulties.

Our plan briefly was based on two principal factors, production and costs, the unit being cost per pound for which a standard cost has been determined, and it is on the relation of actual cost to the standard cost that bonus is paid. If the actual cost exceeds the standard cost, but little bonus is paid. If the actual cost is less or equal to the standard cost, then considerable bonus is paid.

Standard Costs

A standard has been defined as "that which is established by investigation or authority as a reasonably attainable maximum of desirability." For the purpose of illustrating our plan, we will use a figure of 12c. per pound as standard. Bonus is paid according to the per cent. of efficiency attained, by dividing this standard cost per pound by the actual cost per pound, six months' average, determined by the accounting department, and which includes all items of expense such as coal, fuel oil, supplies, repair parts, steel, direct labor, indirect labor, including all supervision and bonuses and scrap charges, if there are any. Assuming the six months' average cost per pound has been found to be 12.5c., then the per cent. of efficiency would be 12c. divided by 12.5c., equaling 96 per cent., which would pay 16 per cent. bonus. For further illustration, let us assume an actual cost of 11.5c., then the per cent. of efficiency would be 104.3 per cent. which would pay a bonus of 24.5 per cent.

It might appear that a payment of 24.5 per cent. bonus or extra wages is high and prohibitive, yet a careful analysis of records will show that such is not the condition. First, we must consider that bonus is paid on wages alone, while the saving is made on all expenses. Suppose a plant turned out 1000 tons of forgings in a month and made a saving of 1c. a pound over any other previous six months' or year's record, then the total saving would represent $20,000. This saving would pay 40 per cent. bonus on $50,000 wages.

However, it should be admitted in justice to all concerned that the success of any bonus plan depends wholly upon the accuracy and dependability of the standard. By all means it must be accurate. If it is too tight or not reasonably attainable, the incentive for extra effort or interest in stopping leaks and losses is lost, and after a few weeks of conscientious effort the worker gives up in despair and says, "Oh, what's the use." On the other hand, if the standard is too liberal and a lot of bonus is made with little effort, the whole thing will be a failure and not only

will the company pay for something and get nothing in return, but the spirit of the chase is lacking, or, commonly speaking, it is "pretty soft." When the standard is right, then you have an entire organization working as a unit, where everyone has an actual interest in everything that enters into the plan, instead of lack of interest as is sometimes prevalent in some organizations.

We all know that in a forge shop there are but a few producers, compared with the total number employed, considering hammermen and helpers as the only producers. I believe that the average is about one to three; that is, including foremen, die sinkers, machinists, repairmen, electricians, plumbers, millwrights, engineers, firemen, clerks, inspectors, steel yardmen, laborers, etc., there are three and in many plants four or five such men for each producer. Therefore give a hammerman three or more enthusiastic, interested, efficient and willing partners, whose efforts are directed in the same channels and for whom rewards for extra effort are equal, and there is no reason why production should not be increased quite materially and the unit cost reduced in a like manner.

The following is a formula used in computing this bonus: Let A = the number pounds of good forgings; B = the cost of fuel oil (gallons times standard per gallon); C = the cost of coal (tons times standard per ton); D = the cost of steel (pounds times standard per pound); E = the total direct labor; F = the total indirect labor; G = the charge for scrap made; H = the cost of supplies needed; J = the credit for sale of flashings, scrap, etc.; X = the actual cost per pound; Z = the per cent. of efficiency; and Y = the standard cost per pound.

Then $B + C + D + E + F + G + H - J = X$

and $\frac{Y}{X} = Z$

An explanation of items B, C and D may be in order, that it may be understood why a standard or permanent cost is used rather than the actual or fluctuating cost. It must be acknowledged that under ordinary circumstances any group of workmen cannot control or have any influence upon what price is paid for coal, oil and steel. They can, however, have a great effect upon the use of these same commodities; therefore, in justice to them, it becomes necessary to set a fixed price for these articles whereby their earnings will only be subject to quantities used and not be affected by what has been of late a more or less fluctuating market. It has also been found far better to compute the bonus on a six months' basis than month by month. On the basis of each month separate there is apt to be an unusually good month with large production and low costs and a large bonus would be paid; the following month conditions may be just the reverse and little bonus paid. At the end of the two months perhaps the total amount paid would have been the same either way, but the more regular these payments are the better men can adjust their affairs and learn to depend on a fixed amount each month.

It is a good plan to keep the men informed as far as possible what progress is being made day by day, and to accomplish this we designed a large sign board.

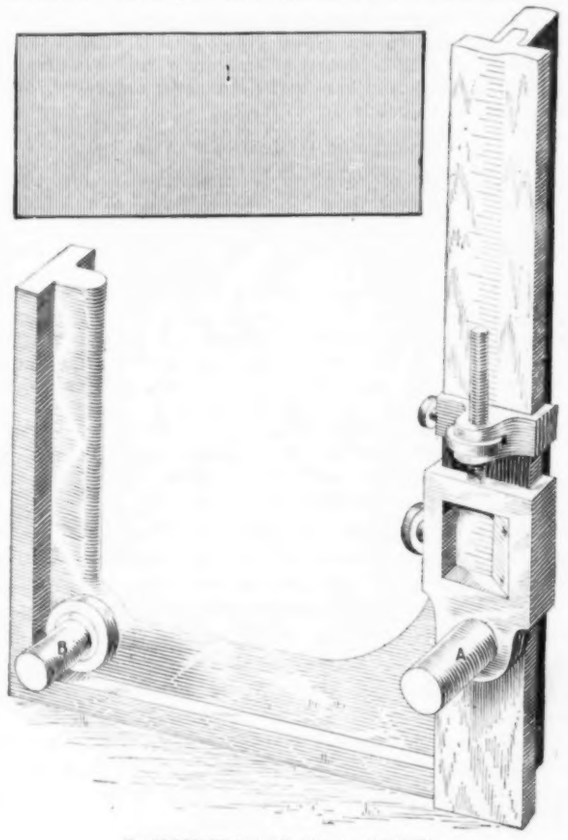
This sign is 10 ft. high by 30 ft. wide, the upper portion being divided into 31 sections, numbered from one to 31, representing the days of the month. In each section is pasted a figure representing a standard tonnage for the day, continuing for each working day in the month. Upon the sign a few slogans, such as "Efficiency Bonus Depends on Cost," "Everybody Can Help," "Do Not Waste Anything." At one end of the sign is painted a large money bag and and at the other end the figure of a workman. A long chute or slide connects the open money bag with the workman's pocket, down which wonderfully real gold pieces are rolling. Unfortunately, however, all the gold does not reach the pocket of the workman, as a lot of it leaks out at the coal pile, some more at a furnace and still some more at a scrap pile, so that a comparatively small amount remains to enter the pocket of the workman. It is these leaks that should be stopped, and it gives me pleasure to state that I know of no better way to stop them than to have the assistance and coöperation of your men. Upon a bulletin board the actual accumulated tonnage to date is posted, which may be compared with the standard for the same period, and which gives every one reliable information as to how production is comparing with what was put up as a standard for the same period.

Tangent Gage for Measuring Angles

JOHN T. CLARK

The sketch accompanying this letter shows an angle gage in which the angle is measured by its tangent instead of the sine.

The body or frame of the gage is a casting or forging, two sides of which are carefully machined to form an angle of 90 deg. while the third side carries a ver-



TANGENT GAGE FOR ANGLES

nier scale parallel to the first side. A slide on this scale carries the vernier and also the measuring stud A. The stud B is forced into a hole bored near the corner of the frame. The graduations of the scale are so arranged that when the vernier reads zero the studs A and B are equidistant from the bottom surface of the frame and, of course, square with its other side.

The center distance between the plugs in this position should be an even number of inches to facilitate computation. Assuming this distance to be 5 in., which makes the tool a convenient size, and that we desire to set it to an angle of 36 deg. 10 min., we find from a table that the tangent of this angle is 0.731 which multiplied by 5 equals 3.655 in. and the setting of the vernier to this measurement is all that is required.

The vernier scale will need to be graduated only to a length equal to the center distance of the plugs as the tangent of 45 deg. is 1 and for all angles above 45 deg. the other face of the square is used and the angle computed from its complement.

The Manufacture of Measuring Wires

By

E. A. Suverkrop,

ASSOCIATE EDITOR, AMERICAN MACHINIST

Wires for measuring the diameters of thread gages are merely plug gages of small size and extreme accuracy. While some of the manufacturers of plug gages guarantee their product to be within one-tenth of a thousandth of an inch in size, there should be less than one one-hundred-thousandth of an inch difference between the diameters of the three wires of a set.

MEASURING wires from 0.007 in. to 0.020 in. diameter are made from high-carbon music wire, which comes in coils. The larger sizes up to 0.495 in. (for measuring two-pitch threads) come in the form of drill rods. The first operation is cutting to length. This is done on an ordinary wire cutter. Varying with the diameter the lengths are 1½ to 3 in. After cutting, the blanks are packed in charcoal in a pipe and carefully annealed, the charcoal preventing decarbonization. The smaller annealed wires are straightened in the small polishing head shown in Fig. 1. The wire is chucked and the operator grasps it between his thumb and the straightener, which is a piece of steel of the approximate shape and dimensions shown in Fig. 2.

FIG. 1. STRAIGHTENING THE ANNEALED WIRES

The wires are then reduced on the ends; the ends of the small ones, by holding them in the chuck in small polishing heads similar to that shown in Fig. 1 and allowing them to rotate rapidly between two smooth files, and the ends of the larger ones, in the bench lathe with a box tool. Some styles of the wires have holes in the ends to facilitate holding them in the gage-measuring fixtures. These holes are drilled in a sensitive drilling machine with the aid of a jig. The wires are next hardened a number at a time in the gas furnace shown in Fig. 3. The wires are packed in short pieces of pipe to prevent oxidation, heated to about 1400 deg. F. and quenched in raw linseed oil. The ends are cleaned in the polishing head, after which the ends only

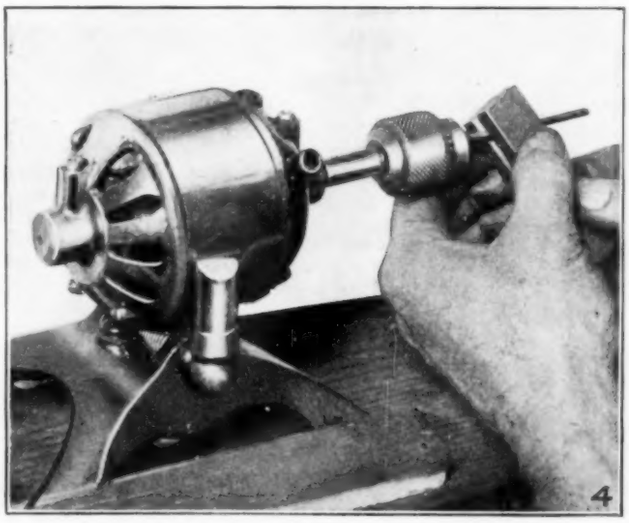


FIG. 4. ROUGH-LAPPING THE WIRES

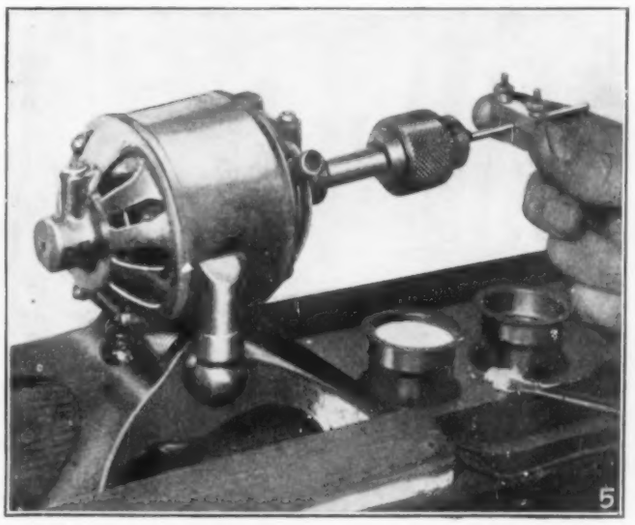


FIG. 5. FINISH-LAPPING THE WIRES

are drawn to a blue with the blowpipe shown in Fig. 3.

Lapping is performed with the aid of a number of small sewing-machine motors similar to the one shown in Fig. 4. Here the operator is rough-lapping with a pair of carborundum oilstones held in his hands. The rough wires are left about 0.003 in. over size, and in the rough-lapping operation are brought to within 0.0003 in. or so of finished size.

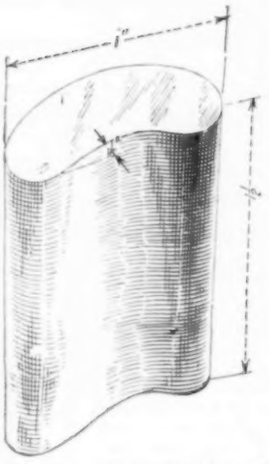


FIG. 2. THE STRAIGHTENER

Finish-lapping is also done on the sewing-machine motor as shown in Fig. 5. The laps are made of cast iron and charged with 60-min. carborundum. The finish-lapping is constantly checked with the aid of a micrometer, the operator comparing his micrometer with a master wire.

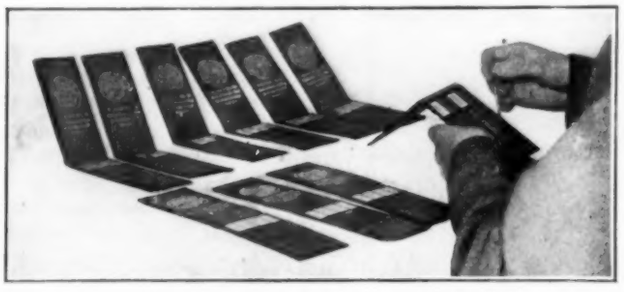


FIG. 7. PACKING THE WIRES

Final measuring of the wires is done with a Prestwich fluid gage, as shown in Fig. 6. This is of course merely an accurate comparator, and is also set by means of a master wire, one of which is shown in front of the machine. After careful checking and counter-checking of their sizes the wires are packed as shown in Fig. 7.

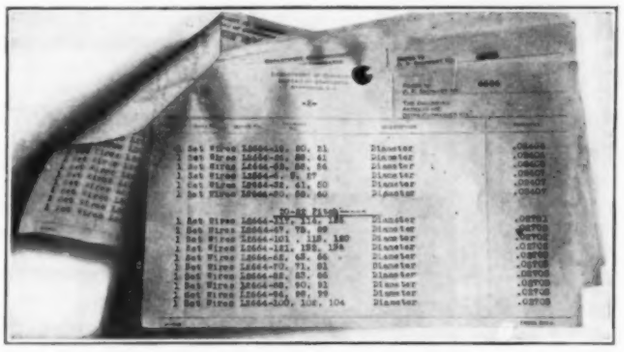


FIG. 8. BUREAU OF STANDARDS REPORT ON WIRES

After packing, all wires are sent to the Bureau of Standards, Washington, D. C., to be measured.

In Fig. 8 is shown a part of a report of the Bureau of Standards on a large shipment of wires submitted by the Fortney Manufacturing Co. Thousands of wires have been sent to the Bureau of Standards, but so far without a single rejection.

The Railway Supply Exhibition at Atlantic City

The exhibition of the Railway Supply Manufacturers' Association held at Atlantic City, N. J., June 18-25, in conjunction with meetings of other member sections of the American Railway Association was large and well attended.

The main exhibit was held on Young's Million Dollar

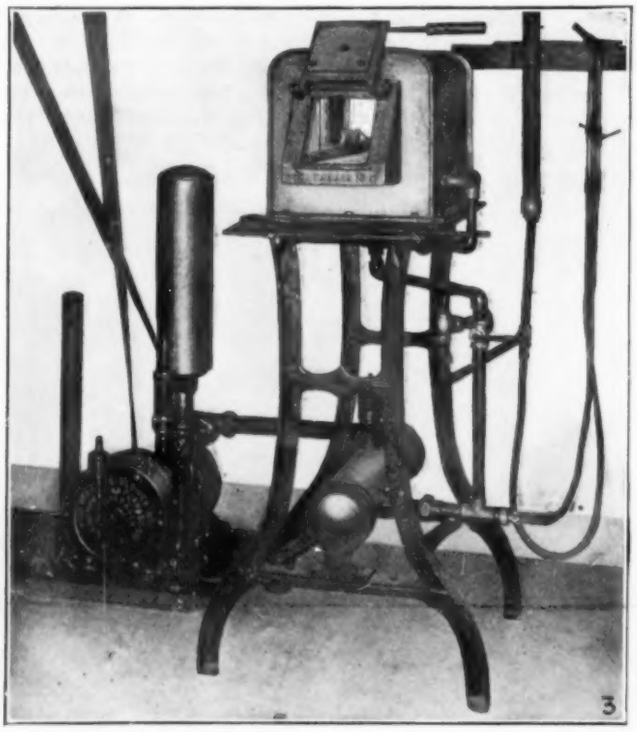


FIG. 3. THE HARDENING OUTFIT

FIG. 6. MEASURING THE WIRES

Pier, but a number of firms were not able to obtain space there and had to install their products on side streets under tents or sheds.

The machine-tool section of the show was the main attraction, as usual, and a number of firms disclosed their newest productions for the first time.

The machine-tool builders having space either on the pier or nearby were:

Acme Machine Tool Co., Cincinnati, Ohio.
American Tool Works Co., Cincinnati, Ohio.
Besly & Co., Charles H., Chicago, Ill.
Blevney Machine Co., Greenfield, Mass.
Bullard Machine Tool Co., Bridgeport, Conn.
Cincinnati Bickford Tool Co., Cincinnati, Ohio.
Cincinnati Grinder Co., Cincinnati, Ohio.
Cincinnati Milling Machine Co., Cincinnati, Ohio.
Cincinnati Pulley Machinery Co., Cincinnati, Ohio.
Davis Machine Tool Co., Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Machine Co., Grand Rapids, Mich.
Heald Machine Co., Worcester, Mass.
Landis Machine Co., Waynesboro, Penn.
LeBlond, R. K., Machine Tool Co., Cincinnati, Ohio.
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio
Lucas Machine Tool Co., Cleveland, Ohio.
Manning, Maxwell & Moore, Inc., New York, N. Y.
National Machinery Co., Tiffin, Ohio.
Newton Machine Tool Works, Inc., Philadelphia, Penn.
Niles-Bement-Pond Co., New York, N. Y.
Oakley Machine Tool Co., Cincinnati, Ohio.
Oesterlein Machine Co., Cincinnati, Ohio.
Pratt & Whitney Co., New York, N. Y.
Ryerson & Son, Jos. T., Chicago, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Penn.
Swind Machinery Co., Philadelphia, Penn.
Warner & Swasey Co., Cleveland, Ohio.
Western Machine Tool Works, Holland, Mich.
Wilmarth & Morman Co., Grand Rapids, Mich.

Others of interest in our field were:

Air Reduction Co., Inc., New York, N. Y.
American Abrasive Metals Co., New York, N. Y.
American Rolling Mill Co., Middletown, Ohio.
Atkins & Co., E. C., Inc., Indianapolis, Ind.
Bastian-Blessing Co., Chicago, Ill.
Boss Nut Co., Chicago, Ill.
Bowser & Co., S. F., Inc., Fort Wayne, Ind.
Brewster Co., William, New York, N. Y.
Buckeye Steel Castings Co., Columbus, Ohio.
Buda Co., Chicago, Ill.
Cambria Steel Co., Philadelphia, Penn.
Carbic Manufacturing Co., Duluth, Minn.
Carborundum Co., Niagara Falls, N. Y.
Carnegie Steel Co., Pittsburgh, Penn.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Crucible Steel Co. of America, Pittsburgh, Penn.
Davis Boring Tool Co., St. Louis, Mo.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Duntley-Dayton Co., Chicago, Ill.
Edna Brass Manufacturing Co., Cincinnati, Ohio.
Electric Controller and Manufacturing Co., Newark, N. J.
Elwell-Parker Electric Co., New York, N. Y.
Foster, Walter H., Co., New York, N. Y.
General Electric Co., Schenectady, N. Y.
Gilbert & Barker Manufacturing Co., Springfield, Mass.
Greenfield Tap and Die Corp., Greenfield, Mass.
Grip Nut Co., Chicago, Ill.
Hyatt Roller Bearing Co., New York, N. Y.
Illinois Steel Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Industrial Truck Co., Holyoke, Mass.
Ingersoll-Rand Co., New York City.
Johns-Manville, H. W., Co., New York, N. Y.
Jones & Laughlin Steel Co., Pittsburgh, Penn.
Joyce-Cridland Co., Dayton, Ohio.
Keller Pneumatic Tool Co., Grand Haven, Mich.
Keystone Drop Forge Works, Chester, Penn.
Liberty Steel Products Co., Chicago, Ill.
Liberty Tool Co., Baltimore, Md.
Ludlum Steel Co., Watervliet, N. Y.
Lukenheimer Co., Cincinnati, Ohio.
Macleod Co., Cincinnati, Ohio.
Metal & Thermit Corp., New York City.
Midvale Steel and Ordnance Co., Philadelphia, Penn.
Milburn Co., Alexander, Baltimore, Md.
Napier Saw Works, Springfield, Mass.
Oxweld Railroad Service Co., Chicago, Ill.
Page Steel and Wire Co., New York, N. Y.
Reliance Electric and Engineering Co., Cleveland, Ohio.
Rich Tool Co., Chicago, Ill.
Rivet Cutting Gun Co., Cincinnati, Ohio.
Simonds Manufacturing Co., Fitchburg, Mass.
Watson-Stillman Co., Aldene, N. J.
Wilson Welder and Metals Co., Inc., New York, N. Y.
Yale & Towne Manufacturing Co., New York, N. Y.

A Patriarch Among Grinding Machines

By Fred Price

The article under the above heading that appeared in the *American Machinist* on page 1096 is interesting, especially the statement that within its limits it would no doubt set a good pace for the most modern of grinding machines.

Our modern toolmakers, many of whom require the latest machine tools and a tool crib full of all kinds of small tools to turn out work that will pass the inspector, will probably smile at the thought of a home-made grinding machine competing with a modern cylindrical machine; nevertheless, I recall that in the shop where I served my time, some forty-odd years ago, we used a toolpost grinding machine something like the one described in the article referred to for grinding plug gages and similar work.

The man who did most of the grinding on this machine was a mechanic of the old school who had to his credit fifty years of experience at the machinist's trade. In grinding plug gages he used a thin elastic wheel made of emery and allowed about 0.0002 in. for finishing by lapping. The work he turned out was in every way equal to similar work ground today on modern grinding machines.

I do not mean to say that the average present-day mechanic could do as well, because the present day toolmaker has lost much of what I call, for want of a better term, "artistic touch," "technique" or mechanical ability which the old timers were obliged to master in order to be able to do creditable work with the tools of forty years ago.

"Within the limits of the machine," however, I assert most emphatically that the old-school mechanic can take one of these home-made grinding machines, generally called toolpost grinding machines, and turn out work that will make some of the beardless toolmakers of the present day "sit up and take notice."

Moral—Although Grandpa's whiskers are long his hands have not lost their cunning.

Note

In the illustration on page 1046, showing special milling attachments, the one in the lower right hand corner should have been credited to the South Bend Lathe Works, South Bend, Ind.

The Detroit Spring Meeting of the

SPRING meeting is the term applied to the convention of 1180 members and guests of the American Society of Mechanical Engineers which met in Detroit at the Hotel Statler on June 16 and held forth for four days. Judging from the actions of the thermometer, "Summer Meeting" would have been a better term. As a result the attendance at the various technical sessions suffered whenever they were held at the same time as any side trip which had a boat ride connected with it. The size of the gathering was gratifying to the officers of the society and to the meetings committee, for it only fell a little short of the 1200 asked for in the preliminary announcements.

Simultaneous Meetings

The schedule of events illustrates the specialization and subdivision of the field of mechanical engineering. From the viewpoint of the man who hates to miss anything, the outlook was most discouraging, for in addition to at least two professional sessions going on at once there were usually four or five committee meetings and the business meeting, which began on Monday and pursued its devious course through various continuations and adjournments until the end of the conference. All this was in addition to two or three inspection trips.

Among the matters taken up in the business sessions was the question of changing the journal of the society "Mechanical Engineering" from a monthly to a weekly. This provoked discussion which threatened several times to become warmer than the weather. The change was finally voted down. From the standpoint of the hard-working mechanical engineer, who feels it his duty to wade through several professional and trade journals each week, this seems a sensible attitude. The fewer the appearances of the more technical of them, the more time will he have to devote to the business of living and getting acquainted with his family.

The Research Session

The research session program included four papers and several reports, and had to be continued into the afternoon. A discussion of the present condition of research work in the United States was presented by Prof. A. M. Greene, Jr., of Rensselaer Polytechnic Institute, who is also chairman of the research committee of the society. The work of the engineering division of the National Research Council was described by G. H. Clevenger of that body. "Organization and Conduct of an Industrial Laboratory" was the subject of the paper by A. D. Little and H. E. Howe, and "Research Work on Malleable Iron" was taken up by Enrique Touceda. The speakers made strong pleas for the extension of research work, not only the industrial or applied type which produces immediate and visible returns, but more particularly the purely scientific type upon which the future of the applied type largely depends. Announcement was made that research into the cutting speeds of metals was to be undertaken at once.

The industrial relations session was something of an innovation and at its close the chairman put the question to the members present as to whether the subject was of sufficient interest to be carried further in future meetings. The sense of the meeting was plainly indicated by the emphasis of the unanimous approval of continuation.

Arthur H. Young described in detail the introduction and workings of the committee system at the International Harvester plants, and L. P. Alford presented a paper on the "Status of Industrial Relation," which was very comprehensive. There was a large amount of discussion, the meat of which seemed to be the feeling that in view of the various "lemons" handed to the workingman in the past, it was essential to meet him more than half way in the future, lay the cards on the table and deal with absolute honesty as man to man. Nothing short of the whole truth would be likely to have any successful results.

The papers presented at the sessions on Wednesday and Thursday dealt with fuels, gas power, power plant and miscellaneous subjects of less interest to machinery men. The meeting ended on Thursday afternoon with trips to the Ford and Packard automobile factories.

The many ladies who accompanied their husbands and fathers were entertained by special automobile trips to the show places of Detroit and were kept so busy that there was little time left to investigate the offerings of the local shops. There may have been some method in this arrangement for even the most elastic expense accounts have certain limits.

The social side was well taken care of, the boat trip to the St. Clair Flats being especially appreciated because of the relief it offered from the heat of the city. In spite of the heat, dancing seemed to be the most popular diversion. It was noted that this was particularly true of those older members whose families had been rash enough to allow them to arrive unguarded. They made the most of their opportunities.

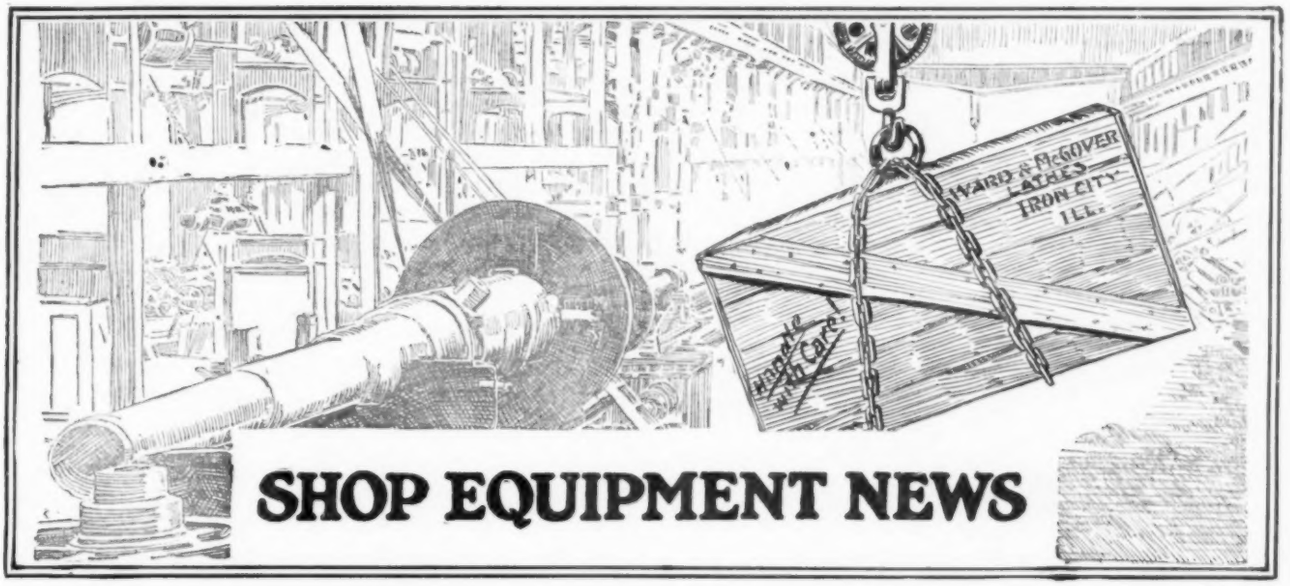
Schedule of Events

Monday, June 16—10 a.m.: Opening of headquarters; council meeting; meetings of committees; consult bulletin-board. 2 p.m.: Business meeting—reports of tellers of amendments to constitution, boiler code committee and committee on aims and organization. 8:30 p.m.: Address of welcome; reception and dance.

Tuesday, June 17—10 a.m.: Research session. 10:30 a.m.: Excursion to Burroughs Adding Machine Co.'s Works; all-day trip for the ladies to Belle Isle, Grosse Pointe and the Country Club. 12:30 p.m.: Luncheon for council and sections delegates. 2 p.m.: Industrial relations session. 2:30 p.m.: Trips to plants of Morgan and Wright Co. and Diamond Power Specialty Co. 8:30 p.m.: Musical entertainment, Arena Gardens, 1253 Woodward Ave.

Wednesday, June 18—10 a.m.: Sections session; gas-power session. 10:30 a.m.: Trip to Connors Creek plant of Detroit Edison Co. 2:30 p.m.: Steamboat trip through St. Clair Flats, afternoon and evening; dinner on boat.

Thursday, June 19—9:30 a.m.: Trip to the Ford Eagle plant. 10 a.m.: Fuel session; general session; special trips to various plants as desired by the visitors; during Thursday several trips for the ladies have been arranged. 2 p.m.: Trips to plants of Ford Motor Co. and Packard Motor Co.



SHOP EQUIPMENT NEWS

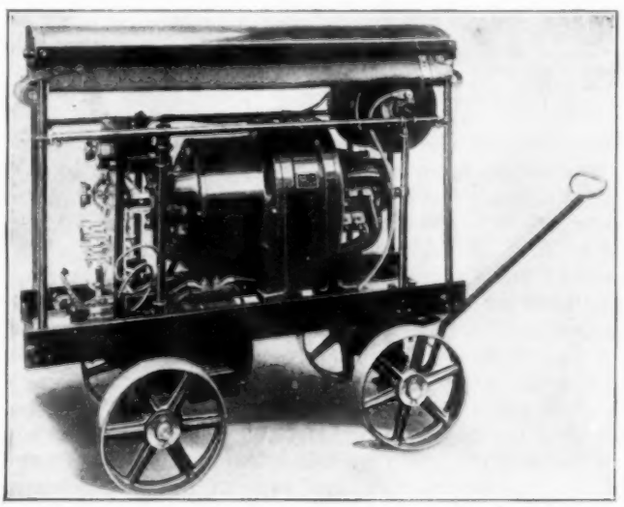
USL Electric Arc Welding Outfits

The U. S. Light and Heat Corporation, Niagara Falls, N. Y., has just developed a line of electric arc-welding machinery for various types of work. For shops where it is practicable to bring the parts to be welded within 50 or 75 ft. of the welding apparatus, a stationary type is provided, but where the work cannot be moved, a light-weight portable machine is furnished that may be taken direct to the work.

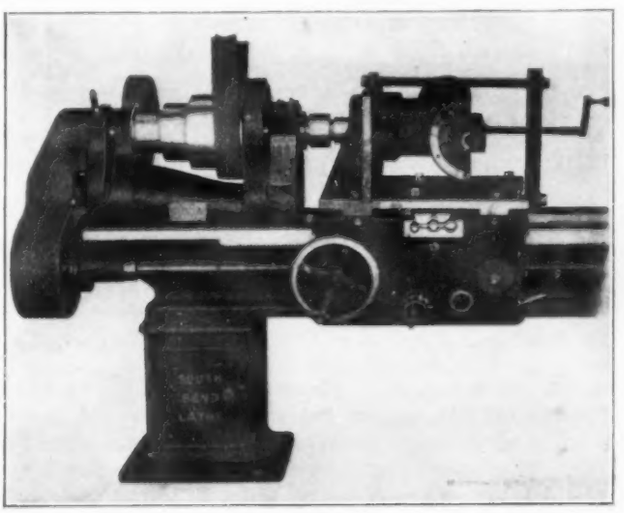
With a rated capacity of 4 kw. the USL arc-welding outfit gives 200 amperes direct current or less, with an arc voltage of 17 to 22 volts, and an open-circuit voltage of 35 to 65 volts. It is made in the form of a converter for use on 100- to 125-volt direct-current circuits only, and in the form of a motor generator for all other alternating or direct-current circuits. The converter set weighs 665 lb. and delivers current to the arc through the arc-stabilizing reactor with an efficiency of 65 to 70 per cent. The motor-generator type consists of a 7½-hp. motor, mounted on the same shaft, with a 4-kw. USL welding generator. This generator is inherently regulated, compound wound, self-excited, with a drooping voltage characteristic, and is claimed to produce an arc peculiarly suited to welding, producing practically constant energy in the arc, and responding instantly when the electrode touches the work. These features insure a strong, steady arc, with a constant flow of metal. For portable use the truck is equipped with a motor generator or converter, and a panel, reactor, cover and cable reel. It is 28 in. wide, 25 in. high, and 54 in. long, and weighs, with complete equipment, about 1500 pounds.

South Bend Cylinder-Boring Attachment for Lathes

The South Bend Lathe Works, 425 East Madison St., South Bend, Ind., has just placed on the market an attachment by means of which any of its lathes can be quickly set up for reboring the cylinders of automobile engines. The illustration shows the attachment in place on a 21-in. lathe, but the device is applicable to all lathes of 15 in. or larger. In putting the attachment in place, the compound rest is removed from



PORTABLE TYPE OF USL ELECTRIC ARC WELDING APPARATUS

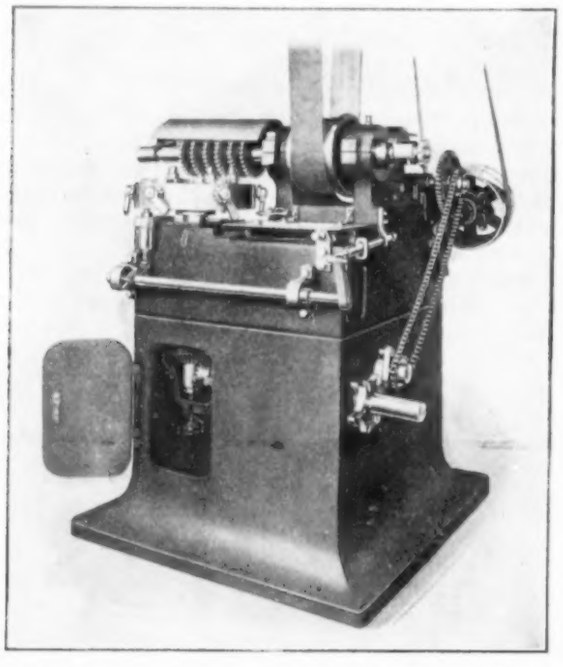


SOUTH BEND CYLINDER-BORING ATTACHMENT FOR LATHES

the saddle, the jib being secured in position by means of two taper pins and bolts fitting the T-slots in the carriage. A feature of the device is the method of locating the work. There is a hole in the attachment in line with the lathe spindle. This hole is fitted with a removable bushing which is in its turn fitted with a plug, on the end of which a shoulder is turned of the same size as the cylinder bore. This bushing and plug are put in place with the end of the plug projecting through. The cylinder is placed over this plug and clamped in place, after which the plug and bushing are removed allowing the work to be done. The boring bar fits into the taper of the lathe spindle and is provided with a cutting tool that will bore holes 3½ to 4 in. in diameter and can be adjusted to the thousandth of an inch. If larger cylinders must be rebored a collar can be fitted in the end of the boring bar to hold cutters of larger size. The attachment is said to be of great value where cylinder boring is only done occasionally as it can be easily put in place or removed from the lathe.

Sanford Semi-Automatic Milling Machine

The F. C. Sanford Manufacturing Co., 2060 Fairfield Ave., Bridgeport, Conn., has just placed on the market the new semi-automatic milling machine shown in the illustration. This has been designed for the milling of valve heads, locknuts or work of a like nature, and has a sliding head which carries the arbor, which in turn carries a gang of six side-cutting mills. The table consists of a chuck having six sets of jaws. To operate

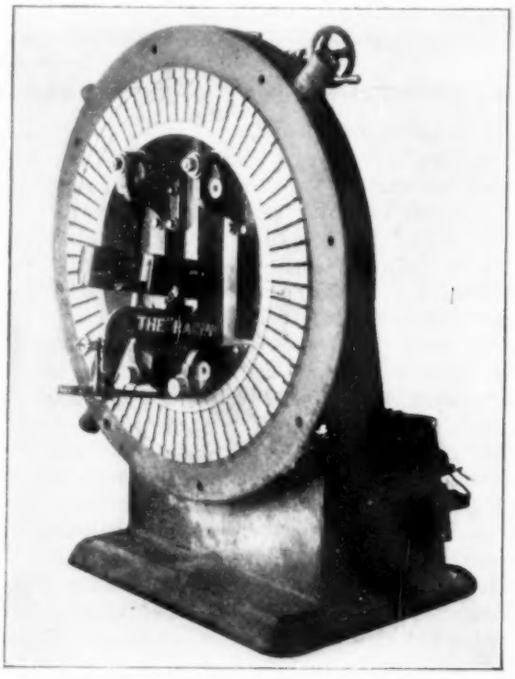


SANFORD AUTOMATIC HUB-MILLING MACHINE

the machine the operator places the work in the first set of jaws. At the end of the reverse stroke the chuck or table turns one-sixth of a circle and automatically locks. The head advances and No. 1 hub is faced on two sides by cutters No. 1 and No. 2. On the second stroke the table has made another one-sixth of a full turn and the second two sides of No. 1 hub are milled by cutters No. 3 and No. 4, as well as the first two sides of hub No. 2. With the third stroke the table has made its full half turn and the last two sides of hub No. 1 are completed, the second two sides of hub No. 2 and the first two sides of hub No. 3. In other words, there is one hub completely milled at every stroke of the machine. With the next move of the table the jaws are reopened and the hub knocked out. In this way the operation is practically continuous. This machine has a capacity of from 4 to 10 hubs per minute, depending upon the condition of the castings.

Racine Roll-Chill-Slot Saw

The Racine Tool and Machine Co., Racine, Wis., has just placed on the market the heavy-duty high-speed saw shown, which is for use on one type of chill used in the casting of chilled-surface rolls. These chills consist of a water-cooled jacket or ring, around the inner circumference of which are a number of cored



RACINE ROLL-CHILL-SLOT SAW

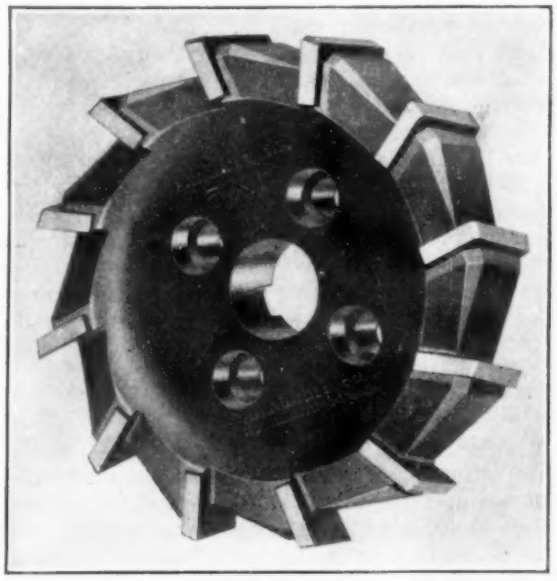
Weight, 2500 lb.; height over all, 64 in.; floor space with belt drive, 40 x 31 in.; driving pulley on belt-driven machine, 12 x 2¾ in.; speed, 90 strokes per minute; blade, 14 in. long; belt, 6 in.; motor recommended for motor drive, ¾ hp.; size of chills handled, inside diameters from 20 to 33 in. with maximum outside diameter of 50 in.; movement of upper rollers, 14 in.

slots to provide for expansion when the ring is heated by the molten metal. These slots do not extend to the inner surface of the ring, but after the chill has been machined it is the practice to saw through from the inside into the slot to provide for expansion. The machine consists essentially of a heavy work-holding base upon which is mounted a portion of the standard Racine saw-holding and operating equipment such as the saw frame, feeding and guiding device and reciprocating mechanism. On the body or frame are mounted two stationary and two sliding roller brackets, carrying hardened and ground steel rollers upon which the inside of the chill ring bear. The two lower brackets are stationary and hold the chill in the proper position with relation to the saw, while the two upper brackets slide on ways in the main frame and may be

raised or lowered vertically by means of a screw feed operated from the crank shown at the left, through a worm-gear arrangement. The face of the body is planed and after the chill ring is placed in position against it, the upper rollers are drawn up until the chill is centered. A further raising of the upper roll serves to tighten or clamp the chill in position. The chill is revolved by hand to the correct position for the first cut, but after this has been made, all succeeding cuts are positively located by a gage. The machine can be furnished for either belt or motor drive, the latter type requiring a motor of ½ horsepower.

Arnold "Economy" Milling Cutters with Brazed-In Blades

The H. H. Arnold Co., Rockland, Mass., has just placed on the market a new line of milling cutters that are said to be made by a new process. High-speed steel blades are used, and these are united to the tough alloy-steel body by a brazing process, and it is said that these cutters are very economical in the medium and larger sizes. They are made at present in sizes from 3 to 8 in. in diameter, with widths from ¼ to 1½ in. The blades are undercut and

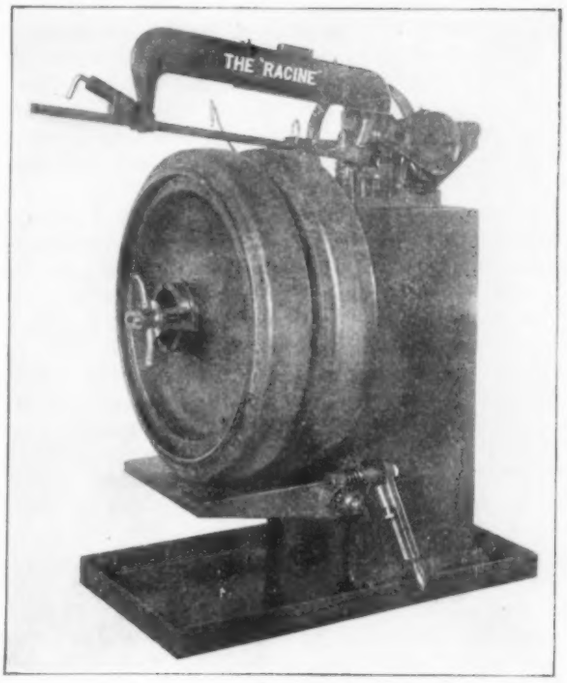


ARNOLD MILLING CUTTER WITH HIGH-SPEED STEEL BLADES BRAZED IN PLACE

backed up by the tough-body stock, and ample chip space is provided. The body material is machinable and the flutes are easily remilled when the blades are worn down, thereby maintaining the correct land and chip space during a longer period than would be possible with a solid cutter. Another feature is that the holes can be rebored, and keyed to fit arbors of larger size if this should at any time become necessary. Also special markings for records are easily stamped on the body.

Racine Tire Saw

The Racine Tool Machine Co., Racine, Wis., has recently developed the hacksaw shown, which is used for removing the steel rims of worn-out truck tires from the wheels. The saw mechanism is mounted on



RACINE TIRE-CUTTING SAW

Weight, 1077 lb.; floor space, 24 x 48 in.; distance from top of platform to bottom of blade with platform in lowest position, 44 in.; height of machine from floor to top frame, 5 ft.; blades used, up to 24 in. long and up to 1 in. wide; travel of platform, 14 in.; height of platform above floor when in lowest position, 4 in.; coolant used and circulating pump provided; diameter of drive pulley, 16 in.; face of drive pulley, 4 in.; speed, 100 strokes per minute.

a sturdy base provided with a platform that may be raised or lowered by a ratchet-lever-driven worm, operating a gear in mesh with a rack cut in the base. After the platform is adjusted to the proper height for the wheel being handled, the wheel is locked in place by a bar passing through the shaft hole. The platform may also be provided with a shallow V-shaped top surface to aid in centering and holding the wheel. The saw frame is arranged to hold any size blade up to 24 in. in length by 1 in. in width, and is so arranged that the automatic control mechanism automatically stops the blade when it has finished its cut, parallel to the felloe. The machine can be furnished for either motor or countershaft drive and is provided with a pulley 16 in. in diameter with 4 in. face. It operates at approximately 100 strokes a minute, and will cut a dual tire 17 in. wide from the rim in approximately 10 min. A pump is provided for circulating the cooling liquid during the operation.

The Status of Informal War Contracts*

By G. H. Dorr
Assistant Director of Munitions

The sudden termination of hostilities on Nov. 11 brought both industry and the War Department face to face with a problem of great magnitude and extreme difficulty. The power, thought and energy of industry had been directed more and more insistently on swelling the rising tide of the production of munitions, with the spring of 1919 as the goal toward which

*Abstract of address delivered before the twenty-fourth annual convention of the National Association of Manufacturers at the Waldorf-Astoria Hotel, New York City. The status of Informal War Contracts.

every nerve was strained for the full exertion of the military power of the United States. Industry had committed itself freely and fully to the larger and larger tasks which the Government was placing before it and the Department had more and more heavily by contract committed itself to industry. With the suspension of hostilities the whole problem, for industry and the Department alike, changed over night.

Speaking generally, a tapering-off policy was adopted so that plants would be largely cleared of work in process and the Government would not have on its hands enormous amounts of semi-finished material, useful neither for the purposes of war nor of peace. The contracts of the War Department in which it was found desirable to curtail production, called for a total expenditure, if they had been carried to completion, of approximately $6,000,000,000. The Department worked out its program of curtailment so far as possible in coöperation with the manufacturers affected, with the War Industries Board and representatives of the Department of Labor. Manufacturers affected accepted this program and took up the task of the shift back to commercial work with courage and initiative. They could not see ahead, but they went ahead. Thanks to this spirit, in the main, the shift back from war industry to commercial work has been effected with a maximum of speed and without widespread hardship or distress.

It was determined not to cancel contracts, but to temporarily suspend or curtial their operation, pending the negotiation between the Department and the contractor of a supplemental contract which would provide for the curtailment of production and the final adjustment of the relations between the contractor and the Government. The contractors, generally, coöperated in this procedure and accepted the temporary suspensions and curtailments at the request of the Department and the work of negotiation of final adjustment was undertaken.

Necessary that the Department Should Deal with Contractors on Uniform Basis

It was important that the Department should deal with contractors, generally, on the same basis. The basis adopted is a simple one to state. First, all articles which are completed under the contract are paid for on the terms provided for by the contract. Second, where the contractor has made expenditures and incurred obligations which do not result in finished products, then the Government reimburses him for his expenditures, protects him in his obligations to subcontractors and in addition, pays him a remuneration for the use of his capital and services which have not resulted in completed products. To state this basis of settlement in more detail, the method pursued is substantially as follows: The contractor is reimbursed for the raw material which he has purchased for the purposes of the contract and is paid interest for the use of his capital which is tied up in that raw material. He is reimbursed for his expenditures on work in process, and in addition, he is paid remuneration up to 10 per cent. of the cost for the use of his services and capital on that work in process. If he has subcontracts he is reimbursed the amount which he is obliged to pay subcontractors in settlement of his obligations to them growing out of the curtailment of production under the prime contract. If, in carrying out his contract, he has provided facilities for that contract and in estimating his price has taken the amortization of those facilities into consideration as an element of price, he is allowed that part of the cost of the facilities he would have recouped if the contract had gone to completion. This is the ordinary basis of settlement to a contractor. It is recognized, however, that there may be special elements in a particular contract which prevent a settlement on this basis from affording to the contractor fair and just compensation for what he has done, and in such cases provision is made for additional compensation.

Department Fortified in Its Decision by Act of Congress

The Department has been fortified in its decision as to the use of this basis of settlement by the action of Congress in the provision it has made in the Act of Mar. 2, 1919, the Dent-Chamberlain Bill, authorizing the Secretary of War to pay, adjust and discharge on a fair equitable basis agreements made under the authority of the Secretary of War, but not executed in the manner prescribed by law. In adjusting these agreements Congress has expressly provided that no profit shall be paid to the contractor except on completed articles and a remuneration for the expenditures he has actually made on that part of the contract on which production has been curtailed. In other words, Congress has given as its judgment that the settlement of such an agreement on a fair and equitable basis does not require an allowance for prospective profits for work and services which are not performed.

On many contracts it is at once apparent that the final disposition of the claim involves some items which take far longer in their determination than others. To make it possible to give relief to contractors in this situation, and to enable them to return more speedily to commercial work, the Department has adopted a plan by which if they are willing to enter into a supplemental contract, agreeing to the basis of settlement set forth above, they may receive payment for items as rapidly as they are determined, or a lump sum equal to a substantial percentage of their claim.

Work of Contract Adjustment Carried on by Essentially Civilian Boards

It is estimated that the total cost to complete the eliminated portions of the contracts up for settlement would be $3,600,000,000. The estimated amount claimed and to be claimed in settlement of this elimination is $700,000,000, the claims being based on the expenditures and commitments of prime contractors and not including any prospective profits to them.

The work of contract adjustment described above has been and is being carried on by organizations essentially civilian in character. Business men of standing have remained in the service as officers or civilians to carry on this work in Washington and in the various localities where settlements are being negotiated. They have developed organizations adequate to handle a task which is unique in the history of the country. In spite of the difficulties to be overcome, more than 75 per cent. of the actual work to be done is behind us.

We are constantly impressed with the general spirit of coöperation and fair dealing very generally animating the contractors affected. They seem to be carrying over into this final winding up of their war relations with the Department to a marked degree the admirable spirit which they so generally displayed in the stress of the nation's military need.

Jottings of a Journeyman—What Are the Ethics in This Case?

By F. L. Ess

One day while we were all busy at our work we heard the boss call to Jackson from the office. We had noticed that the boss had been talking with a stranger in the office for some time, for the office and shop were separated only by glass partitions so that we could see what was going on inside, and incidentally the boss could keep an eye on us.

Jackson was a quiet sort of a man, rather better educated than most of us, and this education he had supplemented by home study in designing and drafting, but he was hardly as aggressive and pushing as some of the others.

Jackson was closeted in the office with the boss and the stranger for an hour or more, and when he came out he got out a drawing board and got ready to go to work at it.

Smith Had an Idea

It seemed that the stranger, whom we will call Smith had been sent to our shop by another customer to have some ideas on a vise developed. Jackson soon found that in order to accomplish what was desired it would be necessary to quite radically modify Smith's ideas, and he sketched something that gave promise of success, which Smith, after some little hesitation, probably because it came a little hard for him to abandon his own ideas, had one made up.

It failed, however, to develop sufficient power, so Jackson made some further changes, putting in some ideas which he had had in mind for a long time. This vise when made up developed abundant power, and the customer who sent Smith in, happening to be in about that time, was enthusiastic about it and told Jackson that that idea ought to be worth 50 dollars. Others who saw it advised Jackson to have it patented. This, however, Jackson was hardly willing to do, for as Smith was paying the bills there was an obligation which he did not feel that he could ignore, so the boss undertook to see what he could do for Jackson with Smith.

Smith Was Not Willing to Recognize Jackson's Right to an Idea

Smith, though pleased enough with the vise, refused to recognize that Jackson had any more than made some good suggestions, and seemed to regard the efforts to have him (Smith) recompense Jackson, and the intimations that others had advised Jackson to patent it himself, as an attempt to hold him up, and told Jackson that in the future he should advise him to keep his ideas to himself. Jackson, rather than to have any trouble about it, and perhaps hoping also to appeal to Smith's sense of fairness, told him that he could do as he pleased about it. Smith then made a few modifications in the vise and claiming the whole thing as his own invention he immediately had it patented, and Jackson got left.

I don't think that Smith ever did very much business with the vise, for though Jackson's ideas gave it the necessary power, certain faults of construction developed which made it impracticable; but if Jackson had any further ideas about it he followed Smith's advice and kept them to himself.

Jackson's experience, however, makes one wonder just what course one should take in such a case. Certainly the fact that Smith was paying the bills did put Jackson under an obligation to him, and we cannot help respecting his scruples in the matter; yet it does not seem as though he was very shrewd to put his own ideas into the vise without first having some understanding with Smith.

Perhaps, though, his desire to work for the interest of the shop may have had something to do with it, for if the vise had been fully successful it would have meant more work for us.

In Retrospect

By Matthew Harris

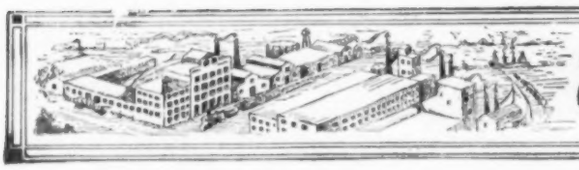
The other day I dropped in to see our old friend Chordal. We got to talking over old times and Chordal brought out a bound volume of sketches of various machines and devices he had schemed out during the last half century. The book contained about 150 sketches (some made as early as 1865) ranging from machine tools to wrenches. And speaking of wrenches reminds me that Chordal asked me if I remembered the Baxter wrench and wanted to know who made it. I remembered the wrench well as I had one in my kit about 1874. It was a double-ended adjustable S-wrench and was an exceedingly handy little affair. I do not know who made it nor why its manufacture was discontinued. Speaking of the Baxter wrench brought the talk up to wrenches in general and Chordal asked me if I knew how the monkey-wrench got its name, and I had to confess my ignorance.

Chordal asked me when I saw the first blueprint. I told him about 1875 and that my recollection was that the late Alexander Gordon and myself happened to be in a machinery house in Philadelphia when a blueprint was received in the mail (I think from France) and the proprietor showed it to us. None of us had ever seen anything like it and we all wondered how it was made. Mr. Gordon, I believe, wrote to the man who had sent the print and in due time received a reply explaining the process and giving the formula for preparing the paper. I do not remember the exact date when blueprints first came into general use, but I know that when I first began to make them (about 1877) there was no blueprint paper on the market and I had to prepare my own. This I did in the evenings at home, allowing the paper to dry in a dark room. When dry it was put in a light-tight box and carried to the shop.

When printing on this paper through tracing cloth an exposure of about five minutes in bright sunlight was required to get a good print. With the advent of the blueprinting machine the paper was made more sensitive to light so that a very much shorter exposure was necessary. I have often wondered what modification was made in the formula for coating the paper to accomplish this.

Chordal said that in a few years from now draftsmen and mechanics would think that blueprints had always been in use and that a history of the subject would be both interesting and instructive.

If some of the readers of the *American Machinist* have any information regarding the things I have been rambling about and will send it to that paper for publication, I think it will be very acceptable.



Sparks from the

France to Buy A. E. F. Supplies

Negotiations for Railroad and Wharves Involve Billion and Half; Biggest Commercial Transaction in History to be Completed in the Next Few Days

The largest commercial transaction in history will be completed in the next few days between the United States and French governments. The final stage has been reached in a deal by which practically the entire overseas property of the American Expeditionary Force will be sold en bloc to France.

The cost of this property to the American Government, according to the inventories, was $1,500,000,000. It includes wharves, steel cranes, warehouses, barracks, hospitals, locomotives, rolling stock, railroad lines, motor trucks, motor cars, munitions, food supplies, machine shops, lumber mills, agricultural implements and office supplies scattered throughout the length and breadth of France.

Through the transaction France will acquire the Bordeaux harbor improvements, including 17 cargo cranes, which more than double the harbor's capacity. Other French ports also profit by American improvements.

The American army leaves in Gievres the world's largest ice plant. The French army is also enriched by more war material than it dreamed could exist before 1914. The French railroads are improved by the addition of yards, locomotives and rolling stock which cost the American Government $132,000,000.

The French public service is further provided with thousands of motor trucks, which originally cost $316,000,000, and will be invaluable in the work of rebuilding the devastated areas.

The largest item in the deal, however, covers quartermasters stores, including thousands of articles which the French government will resell.

Negotiations now practically completed, have been carried on for the United States by the Liquidation Commission, which comprises Judge Edwin B. Parker, of Houston, Tex., chairman; Gen. Charles G. Dawes, president of the Central Trust Co. of Chicago and general purchasing agent of the A. E. F.; Homer H. Johnson, of Cleveland; Henry F. Hollis, of New Hampshire, and Junius G. Adams. Paul Morel, undersecretary of the Ministry of Finance, represented France.

Mr. Adams, the executive secretary of the Liquidation Commission, said that the two governments had reached agreement on all important matters in principle. There remains the fixing of the total price which France shall pay. The Liquidation Commission is confident of a settlement within a few days. According to Mr. Adams, the French government has been very fair, and relations have been of the best throughout the negotiations. The French officials are now completing an inspection of the property.

Fifty million dollars worth of the material also has been sold to a large Spanish concern to cancel an American debit in Spain and thus avoid shipping gold from the United States to that country.

* * *

Champion Tool Works' Plant Sold

C. H. M. Atkins and B. B. Quillen, Cincinnati machinery manufacturers and their associates have purchased the new plant of the Champion Tool Works Co. from H. W. Kreuzburg and A. H. Rosenberg. The purchase price was approximately $300,000.

The property of the Champion company includes buildings with approximately 100,000 sq.ft. of floor space, and consists of six acres of land on Spring Grove Ave. at Winton Place. The buildings are of brick and steel construction, saw-tooth type, and located on the main line of the Baltimore & Ohio Railroad, with a private spur.

The purchasers of the property also control the Acme Machine Tool Co., 2235 Buck St., the Cincinnati Planer Co., South St., Oakley and the Greaves-Klusman Tool Co., 2420 Spring Grove Ave. It is proposed to locate the Acme and the Greaves-Klusman companies in the newly acquired Champion site. Other buidlings are to be added to the plant.

Messrs. Atkins and Quillen two years ago acquired the Greaves-Klusman property.

* * *

Mining and Metallurgical Engineers Will Meet in Chicago

The American Institute of Mining and Metallurgical Engineers will hold its convention in Chicago, Sept. 22 to 26. This meeting promises to be one of decided importance to the industry, as subjects of concern in iron and steel will be under discussion. In addition to the technical program excursions are being arranged to the steel mills at Gary, the oil refineries at Whiting, metallurgical plants at East Chicago and North Chicago, and to the La Salle district where the cement, coal and zinc industries are represented.

American Engineering Standards Association

An announcement of the completion of the organization of the American Engineering Standards Association has just been received. The Association is an out-growth of the standardization work of the Government during the war and was started by combined action of the national societies of civil, electrical, mechanical and mining engineers and the American Society for Testing Materials. These societies invited the War, Navy and Commerce departments to appoint representatives to coöperate with them in the formation of the American Engineering Standards Committee. The new constitution drawn up by this committee and sent to the societies for ratification substituted the name "Association" for "Committee" on account of the wide scope of the interests involved.

The Association does not intend to interfere with standardization work being carried on by any organization. Nor does it intend to initiate any standards. Its purpose is to act as a means of communication between organizations and individuals interested in standards with a view to unifying and simplifying the methods of arriving at standards and preventing duplication. Also to work with similar organizations in other countries to internationalize standards.

Any organization may request the Association to approve its committees, and by so doing becomes a sponsor society. These standards are to be the work of sectional committees of the sponsor society and the committees are to be made up of representatives of producers, consumers and general interests, none of the three groups to form a majority. Approval by the Association may be given in one of three ways—recommended practice, tentative standard or standard; the expecation being that nothing will be approved as standard until it has shown that it is generally acceptable.

In each case the sponsor society will be given full credit and the standard will be published as that of the sponsor using whatever title the sponsor has given it, followed by the statement, "approved by the American Engineering Standards Association."

The need for some organization to provide for the general acceptance of any standard is very urgent and no other means for this exists at present. Other societies have indicated their approval of the arrangement and signified their intention of submitting standards as soon as the organization is ready for action.

World's Industrial Forge

By E.C.Porter
News Editor

Steel Treaters' Meeting in New York

The second meeting of the New York chapter of the American Steel Treaters' Society, will be held in Assembly Room No. 2, Engineering Societies Building, 29 West 39th St., on Friday, June 20 at 8 p. m.

The following program has been prepared by the executive committee after careful consideration: "High-Speed Steel—Its Metallography and Heat-Treatment" (illustrated), by G. J. Horvitz, New York Testing Laboratories; "The Effect of Certain Elements on the Properties of Steels," by N. J. Gebert, Metallurgical Engineer; "Heat-Treatment as Applied to Railroad Materials," by C. B. Bronson, Consulting-ing Engineer's Office, New York Central Railroad Co.

Non-members of the American Steel Treaters' Society will be cordially welcomed. Ample opportunity for discussion of the above papers will be offered and in this discussion non-members are invited to participate.

* * *

Large French Contract To American Firm

The Vulcan Steel Products Co., 136 Liberty St., New York City has just received a cost-plus contract, valued at $200,000,000, for rebuilding the Nancy district of France, according to the report of one of the officers of the Vulcan Co. who arrived in New York this week, after closing the contract in France. Plans for a part of the project are on the way to the United States. The preliminary work of accumulating an organization and obtaining bids on machinery and equipment of all kinds will be started at once, so that the actual construction work may go forward the moment the peace treaty has been signed. Another retarding factor is the present high rate of exchange.

Associated with the Vulcan Steel Products Co. are MacArthur Brothers and the McClintic-Marshall Co., which will handle the construction work. French labor will be used, and it is understood that preference will be given to French manufacturers of machinery. However, a vast amount of American machinery of all descriptions will be purchased.

Although the contract covers all classes of construction, particular attention will be devoted to industrial works, because of the revenue they will produce. For example, it is estimated that 5000 breweries have been destroyed. If only 20 per cent. are rebuilt, it will mean a thousand such plants. In that event it is quite likely that some American manufacturer of brewing machinery will become associated with the Vulcan Co. The same may happen in connection with the cement, textile and other industries. It is possible that a French company will be formed to handle the work over there for the Vulcan company.

Some time ago newspaper dispatches stated that Europe intended to do its own rebuilding, without foreign assistance. It is now recognized that the task is far beyond the capabilities of post-war Europe. The plans for reconstruction are prepared by local committees composed of persons interested in particular districts. The French government recognizes these committees as being responsible bodies. The Nancy contract was let by the committee in that district.

* * *

Re-education Courses Popular

It is difficult even yet to reckon the extent of the problem of reëducating the disabled soldier, but from the experience thus far gained the Federal Board for Vocational Education is convinced that the American soldier is more interested in the offered retraining than any foreign soldier has been. Perhaps this is due to the liberality of the provisions made in our country. Judging from the experience of our Allies, about five per cent. of any given group of wounded men will be given retraining. That would give 10,000 men to be retrained out of the 200,000 wounded, but the Board estimates an even larger percentage among American soldiers as it anticipates that there will be 15,000 or even 20,000 men who will ask for reëducation and placement in industries.

* * *

One Job Hunter for Every Twelve Men Discharged

For every 12 men discharged every month from the army and navy of the United States, the Government has put one man in the field to secure jobs for them.

An army of 24,000 trained men has been mobilized and placed at the disposal of Col. Arthur Woods, Assistant to the Secretary of War, to aid him in obtaining employment for discharged soldiers and sailors. This army comprises all the field agents of the Department of Agriculture, who are to tour every district in the country in an effort to connect the man and the job.

An additional army of many thousands for this work has been gathered from the second lieutenants of the U. S. A., who have been sent all over the country canvassing the large employers and securing their coöperation for the work at hand.

Trade Currents from Western Cities

Defiance Machine Works Closes Contract for $1,000,000 Worth of Machinery for Automobile Plants. Purchasers of Machinery Are Visiting Chicago from All Parts of the Country

CLEVELAND

What may be considered the biggest individual piece of business placed in the machinery field in this district since the signing of the armistice is announced this week by the Defiance (Ohio) Machine Works Co. This firm has just closed a contract for the sale of more than $1,000,000 worth of machinery of every description to one of the largest automobile interests in the Middle West. The equipment is for immediate delivery to plants in Michigan and nearby territory where factories are operated. The equipment is suitable for the production of automobiles and automobile parts. The effect of this order is to require immediate expansion of the business of the Defiance concern. One of the first operations will be the construction of a new foundry building, and the extension of other departments. At least 600 more men will be put on in these different departments.

Another significant development of the week is the placing with several firms here of orders by Pacific Coast interests for machinery required for the contruction of oil-production equipment. This is the first time this year that Coast interests have ventured into the Cleveland territory which, with most distributing and manufacturing firms here, has been confined to the northern half of Ohio. The principal requirements from the Far West are for automatic machines which will be used for pumping machines and similar equipment for oil production. None of the orders are large, being confined for the most part to single machines, but this form of the business is taken as an indication of what is yet to follow before the year has passed.

Locally, demand is confined to single machines from various sources which are increasing in number each week. Among the larger interests which are said to be disposing of old equipment and installing new is the National Screw and Tack Co. In this class of business at the moment lathes predominate.

There is more talk of higher prices for equipment in this district this week, and this is believed to have inspired a lot of smaller consumers of machinery and equipment to come into

the market. Whether this is the influence or not, a careful survey of the district this week shows that business for the first half of June is 10 per cent. above normal for this time of year, a condition quite unusual, as generally at this time a slump in business is expected.

Leading machinery interests are more optimistic this week than for a long time past. This optimism is inspired by the fact that there is more shopping being done by various manufacturing interests, presumably because they seek to obtain ideas for appropriations for new equipment to be ordered in the fall.

CHICAGO

Hot-weather conditions in Chicago have brought an influx of out-of-town buyers. This has served to keep the machinery dealers all busy with shoppers, and sales from the floor have in the case of some dealers exceeded those made by the men on the road. Purchasers have visited here in the past week from Rochester, N. Y., Seattle, Wash., San Antonio, Texas, and numerous other places, these being mentioned merely to show the great stretch of territory which is being served by this market.

Some floor sales which were mentioned ran over $20,000 and the total for all dealers would amount to a considerable sum. Sales by correspondence and by representatives also continue good, all indications pointing to a continuation of the good business of the last six weeks.

Sales by manufacturers to representatives of European buyers are having a tendency to retard deliveries, and for the first time in some months it is becoming difficult to secure spot delivery on certain ordinary tools. Some lines of planing machines and boring mills are requiring not less than three months' time. The manufacturers of these machines state that their business for the first five months of 1919 is in excess of the same period last year.

No long lists of machinery wants have been issued, but the continued, steady stream of sales of from one to a few items is so great as to cause the market to remain in excellent condition in spite of this. No price changes of note have been mentioned.

Personals

E. T. CAUSER has recently resigned as works manager of the R. D. Nuttall Co., Pittsburgh, Penn.

L. H. MESKER, vice president of the Cleveland Milling Machine Co., Cleveland, Ohio, has turned over the duties of sales manager to H. I. MINER.

W. E. MILLAR has been appointed district manager at Pittsburgh for the Cleveland Milling Machine Co., Cleveland, Ohio, it was recently announced.

HARRY W. CHAMPION, president of the Newton Machine Tool Works, Inc., Philadelphia, Penn., has just returned from an extended business trip to England, France and other European countries.

FRANCIS G. ECHOLS, who for the last 20 years has been general manager of the small-tool department of the Pratt & Whitney Co., Hartford, Conn., has resigned and was appointed vice president of the Greenfield Tap and Die Corporation, Greenfield, Mass.

C. A. CALLESON, of 50 Church St., New York City, has been appointed special agent by the Savage Arms Corporation, to dispose of the surplus equipment now being released from their plants. This will cover about $1,000,000 worth of machine tools.

Obituary

GEORGE ELMER WOLCOTT, of the Sullivan Machinery Co., Chicago, Ill., died on May 10, 1919, after a protracted illness. Mr. Wolcott was the New England sales manager and had been identified with the company since 1888. He was born in Claremonth, N. H., in 1868. After attaining a position of responsibility and trust, which he held for a number of years at the Claremont works of the company, he was appointed New England sales manager in 1905, and had made Boston his headquarters since 1911.

JAMES H. BALL, treasurer of the Lincoln Twist Drill Co., died suddenly at his home on Cedar St., Taunton, Mass., June 13. While his health had not been of the best for some time, there had been no developments that caused anxiety, and he had attended to his business duties up to the last, having been at the office of the company most of the day before he died. Mr. Ball went to Taunton from Boston some 12 years ago, as treasurer of the Lincoln Williams Twist Drill Co., and continued as treasurer of the Lincoln Twist Drill Co., which succeeded the older concern on its reorganization. In business circles he stood high as a manufacturer and a successful executive.

BENJAMIN SEBASTIN, 66 years old, founder of the Sebastin Lathe Co., Covington, Ky., died at his home in Cincinnati, June 5. He suffered a stroke of paralysis several months ago, after returning from a visit to Florida, and had been in ill health ever since. He was a lathe manufacturer in Covington for more than 40 years and retired from active business three years ago. He was a member of the National Machine Tool Builders' Association, and had served two terms as an officer of the Cincinnati branch of the National Metal Trades Association as secretary one year and treasurer the following year. His son-in-law, E. E. Stokes, has been head of the Sebastin Lathe Co. ever since its founder retired, and will continue under the same name.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Importer of machinery and textile-mill supplies in Mexico wishes to sell American handle steel pulleys, shafting, hangers, taps and dies, and mill supplies in general. He will also consider an agency for the sale of automobiles. References. No. 29,499.

The American representative of an engineering firm in France desires to secure an agency from manufacturers for the sale of machinery, tools, and supplies. No. 29,515.

An agency is desired by a man in Belgium for the sale of all sorts of electrical goods and machinery. References. No. 29,479.

The French representative of an American firm who is in this country wishes to communicate with manufacturers of automatic labor-saving machines, such as box-making machines, wrapping and stitching machines, automatic weighing machines, book-binding machines, and machines for making candies. References, No. 29,510.

Forthcoming Meetings

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City on June 24-27, headquarters at the Hotel Traymore. Secretary-treasurer, University of Pennsylvania, Philadelphia, Penn.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The International Railroad Master Blacksmith's Association will hold its annual convention in Chicago Aug. 19, 20 and 21. The location of the meeting in Chicago will be announced later.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Annual meeting and election of officers to be held June 28. On June 29 Maurice A. Wilder will be the speaker. Secretary, O. L. Angevine, Jr., Rooms 131-137, Sibley Block, Rochester, N. Y.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Society of Automotive Engineers. Spring meeting to be held at Ottawa Beach, Mich., June 23-27, 1919. Secretary, Coker Clarkson, 29 West 39th St., New York City.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.